Department of Agriculture and Water Supply

ANNUAL REPORT

1 APRIL 1984
to 31 MARCH 1985

REPUBLIC OF SOUTH AFRICA

COMMONWEALTH MYCOLOGICAL INSTITUTE LIBRARY
20 JUN 1984
ST 321A

ANNUAL REPORT

of the

Head of the Department: Agriculture and Water Supply for the period 1 April 1984 to 31 March 1985

Published by Authority

ISBN 0 621 09695 4

Price: (GST excluded)

Local R3,50
Abroad R4,40

Post Free

R.P. 21/1986

Report of the Head of the Department: Agriculture and Water Supply for the period 1 April 1984 to 31 March 1985

THE HONOURABLE THE MINISTER OF AGRICULTURE AND WATER SUPPLY,
PRETORIA

Sir,

I have the honour to submit herewith the Annual Report of the Department.

Dr D.J. Agenbach
Head of the Department: Agriculture and Water Supply

CONTENTS

	Page
INTRODUCTION	1
PLANT PRODUCTION PROMOTION	4
Agronomy research	4
Horticultural research	6
Plant protection research	14
ANIMAL PRODUCTION PROMOTION	20
Animal production research	20
Livestock improvement	24
Blood and chromosome typing	25
Livestock product improvement	25
Veterinary research	26
AGRICULTURAL RESOURCE DEVELOPMENT	31
Resource research	31
ENTREPRENEUR DEVELOPMENT	34
Programmed extension	34
Formal training	36
Agricultural information	37
Agricultural engineering	38
BOTANICAL AND PASTURE RESEARCH	41
Botanical research	41
Grazing research	43
Legume research	44
AGRICULTURAL FINANCE	45
AGRICULTURAL PRODUCTION ECONOMICS	49
Research	49
Training and advice	50
SUPPORTING SERVICES	51
ORGANISATION AND FUNCTIONS OF THE DEPARTMENT	52

EXPENDITURE OF ALLOCATED FUNDS IN 1984/85 FINANCIAL YEAR

TOTAL EXPENDITURE : R484,8 million		
SERVICES	AMOUNT (million)	% OF TOTAL
Financial assistance	R363,1	74,9
Specialised research	R 63,3	13,1
Regional services	R 46,6	9,6
Other services	R 11,8	2,4

INTRODUCTION

Several developments have given the year under review a place in the annals of service to agriculture by the State, services which now extend over a period of exactly 75 years: Departmental reorganisation, the reformulation of agricultural policy by way of a Parliamentary White Paper and the emergency conditions caused by a protracted drought.

The Departmental reorganisation of September 1984 began with the Constitution of the Republic of South Africa (Act No. 110 of 1983) which formulated a new constitutional dispensation and gave recognition to the principle of self-determination of each of the participating population groups, White, Coloureds and Indians, which, in accordance with the Constitution, affects each of the three groups separately in respect of maintenance of identity and maintenance and promotion of way of life, culture and traditions and which were designated as **own affairs**.

White **own affairs**, by way of five portfolio groupings, falls under the Administration: House of Assembly as administrative section of the Ministers' Council concerned. These groupings are Agriculture and Water Supply; Budgetary and Auxiliary Services; Local Government, Housing and Works; Health Services and Welfare; and Education and Culture. Each of these groupings is represented by a Minister in the Ministers' Council of the House of Assembly and by a Head of Department in the top management of the Administration: House of Assembly. For the sake of completeness it may be added that the sister department, Agricultural Economics and Marketing - directly represented in the Cabinet - is responsible for **general affairs**, including marketing and regulatory functions.

In accordance with the constitutional mandate - to promote optimum agricultural production and the welfare of the White farming community - the following services and assistance measures have been allocated to the Department of Agriculture and Water Supply:

- Agricultural development services, including research, advisory services and extension
- Training at colleges of agriculture
- Financial and other assistance to farmers or prospective farmers or for the promotion of agriculture
- Water supply, including irrigation and drilling works

For the execution of its duties the Department primarily relies on a Top Management consisting of a Head and six Chief Directors who are respectively responsible for co-ordination, agronomy, horticulture, animal production, farming development and auxiliary services.

Where Top Management is responsible for the overall planning, co-ordination and evaluation of the extensive task, its implementation is the responsibility of 24 institutions - each with a Director in charge - consisting of seven agro-ecological regional organisations, 11 research institutes and six directorates.

Information concerning the organisation of the Department and the research fields/functions of the 24 institutions appear in a chapter of this Annual Report.

It is remarkable and a happy coincidence that the structural adjustments to services to agriculture, as outlined above, virtually coincided with the reformulation of agricultural policy as embodied in the 1984 White Paper. The circumstances in which its inception and acceptance by the Government occurred, are briefly as follows:

Although agriculture contributes only 6% to the gross domestic product of the RSA, it is one of the key industries without which the country could not survive and grow. Despite the limited agricultural resources and their vulnerability -

- agriculture supplies virtually completely in all the food and fibre requirements of a population of 27 million which is not only growing rapidly, but of which the standard of living is increasing
- it supplies a wide range of indispensable raw materials to manufacturing, processing and distribution industries
- it is a major consumer of products of trade and industry
- it is an important employer which, because it is practised throughout the country on individual farms, makes a valuable contribution to the deconcentration of economic activities
- agriculture earns a large amount of foreign exchange

The welfare of agriculture does not only affect the farmer, the rural areas and secondary industries that are consumers of agricultural products, but, due to its inputs and outputs, it has an important influence on the national economy as a whole.

The vulnerability of agriculture because of its dependence on nature, was brought strongly to the fore by the recent devastating droughts. The adverse effect of the drought on the national economy, the financial position of the farmer, the urbanite and the city dweller again emphasised the industry's strategic role in the national economy. The grave effects of the drought and the vast extent of financial assistance by the State emphasise the importance of a long-term strategy to conserve the limited natural resources and to use them to optimum advantage, thereby sustaining the rural areas where 47% of the population lives and 32% of retail sales are made.

It is this urgent need for a long-term strategy which compelled the Minister of Agriculture, assisted by his Department and Organised Agriculture, to spell out the aims and objectives of agricultural policy in a White Paper. This can be called a manifesto which lays down broad long-term guidelines for further policy determination.

The objectives outlined in the White Paper are of a three-fold nature: production, marketing and general.

For the purposes of this review and taking into account the thorough discussion of the document by both Departmental spokesmen and leaders of Organised Agriculture, a simple tabulation of the objectives will suffice:

Production

- The pursuance of optimum use of natural agricultural resources
- The retention of agricultural land
- The pursuance of a maximum number of well-trained and financially sound owner-occupant farmers
- The optimum use of labour

Marketing

- The pursuance of orderly marketing, taking into account the principle of the free-market system
- The maintenance of specific quality and hygiene standards of agricultural products

General

- Self-sufficiency in respect of food, fibre and liquor and the supply of raw materials to local industries at reasonable prices
- Optimum participation in the international trade in agricultural products
- The contribution which the industry can make to regional development
- The promotion of agricultural development in Southern Africa in particular and Africa in general
- Encouragement of free competition provided that it can be reconciled with the country's interests and takes account of the uniqueness of the industry

According to the White Paper the measures to be taken to realise the stipulated objectives are also of a three-fold nature:

- The legal instruments required to achieve this
- The administrative or Departmental structure to implement and monitor the necessary programme of action in an orderly and purposeful manner
- Financing measures

The final paragraph of the White Paper envisages priorities in respect of the objectives and the introduction of an associated programme of action. At the end of the year under review, March 1985, it was already clear that priority should be given to a programme of action to put optimum resource use in top gear.

To give the reader some perception of the motivation for this, it is necessary to briefly glance at a few aspects of the resource situation and more specifically at the veld as resource.

Comparatively speaking the RSA is poorly endowed with agricultural resources. A quarter of the country has an annual rainfall of less than 200 mm and two thirds records less than 500 mm. If 500 mm is regarded as a threshold value for successful crop production, only one third of the country has a rainfall that can be regarded as being adequate for the production of basic staple foods.

Because of additional limiting factors (topography and effective depth) only 15 % of the area of the RSA is arable. Another potential-restricting factor is the scarcity of permanent rivers. Of the total run-off of 54 000 million m^3 water, only 57 % can be economically used.

A direct result of the low rainfall is the exceptionally high incidence of disaster droughts. Of the 177 districts, 76 % (122) were on the grazing distress list for 12 months and more during the period July 1978 to June 1984. During the period 1978/85, R480 million was paid towards all forms of drought assistance. Drought assistance to **livestock** farmers came to R112 million during the year under review compared with R96 million in the preceding fiscal year. Drought assistance to **crop farmers** in the form of interest subsidies on carry-over debts and new production credit increased from R27 million in 1983/84 to R125 million in the year under review.

The indirect production losses, the deterioration of the resources and rural disruption cannot, however, be calculated in terms of rands and cents.

The vegetation which is, in fact, the result of an interaction between soil, climate and topography, has, as a result of the above-mentioned limiting factors, a very low grazing potential on about two thirds of the area of the country.

Apart from the natural controls that determine grazing potential, the grazing animal and the soil user are the predominant elements responsible for the quality and quantity of the natural grazing. Over-grazing is generally accepted as being one of the main causes of veld deterioration. Some experts regard injudicious grazing as an even greater evil.

Departmental circles are agreed that the prospects of progress on the terrain of conservation farming are slight if these grazing malpractices cannot be completely eliminated.

Regarding the condition of natural pastures, a recent survey indicated that only 10 % is in a "good" condition. It is estimated that 30 % is in a fair condition and that the remaining 60 % can be classified as poor to very poor.

Against the background of such an alarming situation a programme of action, a National Grazing Strategy, was documented shortly after the end of the year under review.

This strategy is aimed at utilising, developing and managing the natural and cultivated pastures in such a way as to derive the greatest sustained benefit for the present generation while retaining the production potential to meet the needs of the decades ahead.

Prerequisites laid down by the Department for achieving this objective are:

* The restriction of livestock numbers to the prescribed long-term grazing capacity as determined by climate, soil and vegetation. The instrument to be used to achieve this is the Conservation of Agricultural Resources Act, 1983, which prescribes grazing capacity norms for all parts of the country
* Guidelines for adapted systems of use for each homogeneous grazing area must be determined and implemented by the farming community
* Guidelines must be laid down for supplementary and alternative animal production strategies that do not depend solely or mainly on natural and cultivated pastures

To ensure success for the National Grazing Strategy, control measures have been introduced under the Conservation of Natural Resources Act in collaboration with the Department of Agricultural Economics and Marketing. Inspectors of the Directorate of Soil Protection will give high priority to cases where the prescribed grazing capacity restrictions are disregarded and there will be no hesitation to act in cases where veld deterioration can be attributed to injudicious actions on the part of the soil user.

It has been accepted as policy that in future no financial assistance under the 1983 Act will be considered for soil users who do not comply with specific requirements in respect of veld use and veld sparing practices.

The Department has laid down grazing capacity norms for all parts of the country and high priority will be given to research to refine and improve these norms on an ongoing basis. Moreover, the Department will also initiate research to create reliable drought indexes and to develop a service to inform stock-farmers in good time about the expected influence of changing climatic conditions on the grazing capacity. Points of reference to monitor changes in veld conditions over a period of time will be introduced throughout the country.

Funds will be supplied - within the financial means of the State - to eliminate identified shortcomings in basic pasture research and to create an organisational structure to co-ordinate and direct pasture research on a national basis.

The Department would like to take this opportunity to express its sincere appreciation for the support of Organised Agriculture to the Government's policy initiatives to make agriculture an independent and financially sound industry. Seen against the sombre background of cash-flow problems and increasing debts, caused by the disaster drought, as well as increasing risks and declining profits, the result of the prolonged recession, this willingness to co-operate and the new attitude towards the production and conservation task are even more praiseworthy.

The new policy objectives and the grazing strategy naturally also imply new obligations and fields of work for the personnel of the Department. This is particularly true of the diminished corps of professional officers responsible for research and extension.

According to an American agricultural publication (**World Farming Agrimanagement**), some 85 % of the projected production increase in world agriculture by the year 2000 will depend on greater resource productivity, and a mere 15 % on expansion of the tilled soil. Greater investment in research and extension will be required as the turn of the century approaches to stimulate **development** and the **implementation** of technology to increase productivity. It is obvious that the agricultural researcher and the agricultural extension officer are at the centre of this projection.

In the South African context this finding warns the tax payer, the legislator and the industry that drastic revision of both the manning and the funding of the Department's input towards a vigorous agricultural industry and a stable farming community will become increasingly urgent in the years ahead.

PLANT PRODUCTION PROMOTION

AGRONOMY RESEARCH

Summer grain

Maize

Breeding - Despite the extreme drought of the past season, positive results were achieved, and the high lysine hybrid HL2 with an average yield of 6,4 t/ha compared favourably with the 6,8 t/ha of the best hybrid in these trials.

It appeared from comprehensive cultivar trials that the new white hybrids have a poorer yielding capacity than the yellow hybrids and that this situation requires urgent attention if the white hybrids are to compete with the yellow hybrids in respect of production in future.

Good progress was made with the development of breeding material that affords better resistance to the maize stalk borer *Busseola fusca*. Indications were also found that the breeding material contains good genetic variation for resistance to the sorghum borer *Chilo partellus* as well. There are indications that this pest may increase and attain pest status, especially with the increasing application of mulch cultivation. The timeous development of cultivars or hybrids with higher resistance to the insect would therefore mean a great deal to the industry.

With regard to drought resistance, an intensive study of available material was again made during the past season and it appeared that the growing period is still an important property to be considered when selecting hybrids for drought adaptation. The shorter growing season types tend to survive protracted droughts better than the longer growing season types. Furthermore, types with good synchronisation between pollen shedding and silking are better adapted to drought.

Cultivar evaluation - The adaptability of commercially viable cultivars was again tested throughout the country. The results of these tests, in combination with results obtained in previous years, serve as a guide to producers in the choice of cultivars and are also of importance to seed firms with regard to seed multiplication and the release of new cultivars.

Plant pathology - The epidemiology of root, stalk and ear rot was studied over a period of three years. The disease was severest during years with the poorest rainfall and highest temperatures. Nematodes do not appear to play a significant part in the development of root rot. Another finding was that stalk rot has little effect on yields, but that ear rot has a significant effect. Low potassium levels in the soil appear to promote stalk rot. These diseases are extremely important in both maize and grain sorghum, first owing to the effect they have on drought resistance or drought tolerance and secondly owing to the problems associated with lodging. Lodging interferes with harvesting, and the quality of the grain is adversely affected when it comes into contact with the soil.

Entomology - Several experimental synthetic pyrethroids show promise for the control of the maize stalk borer *Busseola fusca*, but still complicate control of the grain sorghum stalk borer, *Chilo partellus*.

Plant nutrition - It emerged clearly from the analysis of long-term experimental data that reliable soil analyses are indispensable to the planning of a fertilising programme. The research programme in respect of the development of standards for liming levels again pointed to the benefits of liming on the basis of exchangeable aluminium rather than liming according to soil pH in the traditional way. Striking differences were also found between cultivars with regard to tolerance to high aluminium levels in soil.

Soil cultivation - In a country-wide programme launched in the summer field cropping areas especially promising results were obtained on a bleached sandy soil in the Bothaville district where the rip-on-row treatment produced a yield of 5,2 t/ha as against 1,3 t/ha from the treatment where the usual practice of mould-board ploughing was followed. Owing to underground compaction, root penetration was restricted to the topsoil with mouldboard ploughing, whereas rip-on-row cultivation breaks the compacted layers so that the roots can penetrate the deep subsoil and therefore gain access to the underground moisture reserves, enabling the plant to survive drought very well.

Small grain

Wheat

Breeding - Three lines that could possibly be released as cultivars shortly were identified in the winter and intermediate wheat breeding programmes. Two new spring wheat cultivars have now been finally released for planting in the winter rainfall area. Palmiet, an A wheat, cropped 16,1 % better than the standard and Gamtoos, a B wheat, performed 15,6 % better.

Pre-harvest sprouting of the grain is a major problem in the Free State in particular. Resistance to pre-harvest sprouting was confirmed in local adapted material for the first time.

Three lines being considered for release show good resistance. A durum cultivar, Moni, from the breeding programme of the University of Stellenbosch was provisionally released for the Fish River irrigation area. Eight barley lines from the local breeding programme with the same yielding potential as Clipper have been identified and are very promising for the future.

Cultivar adaptation - It was possible to make recommendations for both the winter and the summer field cropping areas on the basis of country-wide adaptation trials, and the number of

cultivars recommended for planting are being reduced to 10 and 14, respectively, which greatly facilitates the task of the agricultural adviser and extension officer and the producer who has to make the choice.

Plant pathology - A new form of the fungus that causes crater disease on the Springbok Flats has been identified, namely *Rhizoctonia solani*.

Genes that provide specific resistance to leaf rust, namely *LR* 9, *LR* 19, *LR* 21 and *LR* 26, have been identified. A study of wheat lines and cultivars that are resistant to leaf rust at the adult plant stage only showed that these sources can be effectively used and that the path of inheritance of resistance is known.

Entomology - It has been established that the primitive wheat species *Triticum monococcum* has good resistance to the Russian wheat aphid and that plants with antibiotic resistance have been identified from crossings between *Triticum monococcum* and *Triticum durum*.

Economic threshold values for use in the chemical control of the Russian wheat aphid have now been established and the growing stage during which the plant is the most sensitive to infection has been identified.

Oilseeds and protein seeds

Sunflowers

Soil cultivation - Dike cultivation and manna mulches have been found to be useful methods of counteracting run-off and improving the infiltration of water on the Springbok Flats. These methods produced increases in the yield of 52% and 49%, respectively. Dike cultivation consists in the cultivation of soil with an implement that leaves the surface shaped into dikes or small dams that prevent rainwater from running off.

Soya-beans

International co-operation with Intsoy was maintained and extended to AVRDC (the Asian Vegetable Research and Development Center) in Taiwan. Valuable genetic material is obtained from these sources and is being systematically built into locally adapted cultivars. The newly released cultivar Edgar is doing well in cultivar trials and there is a great demand for seed.

It was found in plant nutrition studies that soya-beans do not have high phosphate requirements. A positive response was obtained up to 10 to 14 ppm of P, depending on the soil type. The response to P fertilising is largely dependent on liming. Soya-bean cultivars differ greatly in their response to soil sourness and this can be important to breeders who are breeding cultivars for soils with a low pH.

Groundnuts

Breeding - One groundnut breeding line, namely 52G25, with resistance to black pod-rot *Chalara elegans* has been identified. Acceptable resistance was also found in the cultivar Norden. Together with its high yielding potential, this makes Norden a candidate for release.

Pathology - A water-soluble substance that stimulates the growth of *C. elegans* was found in the shells, seed and roots of the cultivar Sellie. On the other hand a substance that suppresses the growth of *C. elegans* was found in the resistant line 52G25. These findings make it possible to distinguish between resistant and susceptible lines in a breeding programme.

Dry beans

Breeding - The dry bean breeding programme for the canning industry received a boost with the release of Kamberg, which combines a high yield with seed-fast pods and acceptable levels of resistance to rust.

Other crops

Tobacco

Breeding and selection

Flue-cured tobacco - Breeding lines that are resistant to black shank, mosaic and mildew and also to *Meloidogyne javanica* and *M. incognita* have been developed from a crossing between TL33 and nematode-resistant sources.

Two promising lines are being evaluated for commercial cultivation in trials. If quality determinations and smoking tests produce satisfactory results, these lines will be released for commercial production.

Burley tobacco - Crossings of Greenville 107 with CB17 and CB37 produced outstanding lines with regard to quality and resistance to disease, among others against races 2 and 4 of the potato Y virus.

Oriental tobacco - Highly productive and resistant lines were tested for quality. A start was made with the transmission of the yellowing factor.

Air-cured tobacco - High-yielding South American cultivars and local cultivars of high quality were back-crossed for resistance to black shank, mildew and mosaic. Crossings between both types of cultivars produced a few promising selections.

Cultivar trials were extended to the Gamtoos and Parys/Potchefstroom areas.

Germ plasm bank - The computerised cataloguing of the tobacco germ plasm collection was begun; the object is the orderly storage, maintenance and description of the collection of local and overseas species and cultivars.

Diseases and pests

Black shank - The black shank fungus has not as yet built up resistance to metalaxyl and this preparation protects tobacco plants for 12 weeks. Mancozeb, a component of the metalaxyl-mancozeb mixture, causes phytotoxic symptoms on young plants and should therefore only be administered to the bed three weeks after emergence. The cultivars Speight G28 and TL33 survived well on heavily infected soil that had been treated with metalaxyl. The black shank fungus population was significantly reduced in rotational cropping systems with crops that included tobacco, wheat, oats, maize, cotton, green peppers, sunn hemp and babala, but only where blue buffalo grass was included for two or three years.

Black root-rot - The chemical preparation propiconazole was found to be very effective for the control of the black root-rot fungus.

Bollworm and aphids - The pyrethroid cypermethrin produces the same results as carbaryl, but the residual period is shorter than in the case of acephate and carbofuran. A 20% emulsifiable concentrate of cypermethrin (with 60/40 cis/trans isomers) causes an off-flavour in tobacco at a very low dose. The administration of aldicarb controls aphids for 21 days and control lasts for 28 days with carbofuran.

Nematodes - Only races 2 and 4 of *Meloidogyne incognita* were found in tobacco areas, so that the resistance of the present cultivars to races 1 and 3, which do occur overseas, has not been established for certain.

The percentage of clay in a soil does not affect the penetration of larvae into roots. Early infestation of tobacco by nematodes causes the greatest damage.

Control of weeds and suckers - The application of metazolachlor prior to planting controls annual grasses well. Good sucker control is obtained by means of dinitroanaline (0,8 - 1,3 ℓ/ha dissolved in 300 - 500 ℓ of water). For effective control a follow-up application of 1,5 ℓ/ha of flinetrialin is required, however.

Quality

Curing of air-cured tobacco - The major difference between total and marketable yield (over 40% on average) is disturbing. This is caused by green, broken and variegated tobacco. It has been demonstrated that tobacco harvested ripe can be browned and coloured with the aid of its own moisture, using controlled ventilation only. Sprayers are unnecessary.

Fermentation of air-cured tobacco - Loose-leaf tobacco can be successfully fermented in small stacks without the growth of mould. This results in a price improvement of 116% in comparison with traditional stacking. Producers could apply this method with profit.

Cotton

Breeding - 150 breeding lines were added to the germ plasm collection. The first step in the breeding programme was the development of a series of varieties and breeding lines that are well adapted in the RSA. Selati and breeding line 638 spin and yield better than Acala 1517-70. Breeding line Nebo 108 produces well under dryland cultivation. OR lines have resistance to *Verticillium* and Vlakte is resistant to red spider mite. The following step is the recombination and selection of these lines so that commercial cultivars can be developed. The cultivars Gariep and Acala SJ5 were released for commercial cultivation. Gariep yields better if the stand is larger than 50 000 plants per ha. In addition, 12 new entries were tested as potential cultivars at 18 localities.

Diseases and pests - On soils that are severely infested with nematodes EDB fumigation doubles the cotton crop. Rootknot nematode is commoner in irrigated soils than under dryland conditions. Of the parasitic nematodes the lesion nematode is the commonest. Of the international races 3 and 4 of *Meloidogyne incognita* that attack cotton, only race 4 was found in a nation-wide survey.

Crop cultivation - High potassium fertilising often produces a reduced potassium uptake in crop yield if the calcium status of the soil is low. Where high potassium fertilising was applied the application of gypsum boosted cotton yields. When excessive vegetative growth is expected the growth inhibitor mepiquat can control plant height if administered at low concentrations.

The seed cotton yield is reduced by 35%-45% if moisture stress occurs during the period 80 to 100 days after planting.

To ensure good yields, a favourable irrigation programme is required from the beginning of flower bud formation to 120 days after planting. There are very small cultivar differences in respect of leaf water potential or relative leaf turgidity.

The cultivars Albar 627 B70 and Komatie grow considerably more luxuriantly than Acala 1517-70, but do not differ in respect of yield.

Run-off of irrigation water, rain and soil erosion are reduced by planting on banks and forming dikes at right angles to the earth banks at specific intervals.

HORTICULTURAL RESEARCH

Pomes and drupes

Apples and pears

Rootstocks - The performance of 18 different clonal rootstocks was studied in four different localities and soil types during the past 15 years. Results proved that the rootstocks M793 and MM109 could be considered best for Golden Delicious and Granny Smith cultivars. Dwarfing stocks drastically reduced vigour and increased the incidence of sunburn significantly.

Early heavy crops and high-density planting are essential to offset high initial costs and the performance of trees on M793 rootstocks at a 2,7 m x 3,6 m spacing indicated that it would be the most suitable rootstock on low and medium-potential soils.

Clonal stocks reduced the vigour of Granny Smith trees more drastically than that of Golden Delicious and the vigour of full-bearing Granny Smith trees on M793 stocks was often insufficient to reduce the incidence of sunburn.

Sunburn is a serious hazard in Granny Smith trees and the MM109 rootstock is considered superior to M793 rootstocks for this cultivar on medium-potential soil because of the fact that it induces more vigour and improves the leaf cover.

Seedling stocks performed poorly in all the trials. However, observations in commercial plantings indicated that M793 stocks were poorly adapted to soils with a clay content of less than 10 % and seedling stocks are therefore preferable for such soil types.

The different clonal stocks had no significant effect on fruit size or the incidence of bitter pit. Fruit from trees on EM7 stocks reached maturity approximately 10 days earlier than on the other stocks, which will make this rootstock of interest to growers that grow fruit from the early market.

This information is regarded as invaluable to the apple industry, since it serves as a basis for making the correct choice of rootstocks for different conditions.

Training systems - The effect of different planting and training systems on the production, fruit quality and net income of Golden Delicious and Granny Smith cultivars was studied in a planting and training trial at the Grabouw Experimental Farm from 1966 to 1985.

Results proved that higher-density planting is more economic than wider spacing and a positive net cash flow was recorded during the eighth year after planting for Golden Delicious and the tenth year for Granny Smith at a planting density of 1 500 trees per hectare. The high cost of planting and training material and labour required to establish these high-density plantings was offset by the increased production of the systems and yields of 100 metric tons per hectare were maintained during the past nine years.

The results of these trials established the most economic planting system for apples and are therefore of the utmost importance to the apple industry.

Nutrition - The ability of orchard soils in the Western Cape to provide potassium depends on various factors. Although all the soils that were investigated show a preference for the absorption of K where there is low saturation, reversion of applied K was noted only in soils from Table Mountain sandstone and Bokkeveld shale. Although granite soils contain large amounts of K that are available to plants, they are poorly equipped to counter K withdrawal.

This consequently leads to the initial absorption of a great amount of K, which quickly becomes depleted, which in turn leads to a shortage of K for plants.

This information is very important because it could serve as a basis for the establishment of scientifically founded and economically justified potash fertilisation programmes.

Crop science - An economic evaluation of the results that have been obtained thus far with the overhead cooling of apples was carried out. The cost of establishing an orchard with overhead cooling increases by approximately 60 %, from R8 500 to R13 800 per ha.

There was, however, an average increase of 25 % in the gross income per year - from R13 500 to R17 700 per ha - while maintenance costs increased by only approximately 12 %. If initial costs are recovered over a period of 20 years at 20 % interest, it is estimated that there would still be an increase of 30 % in the average net income per year. It is therefore evident that the application of this system in practice would be of great economic benefit to the apple industry.

Pests - Codling moth is the most important insect pest in apples and pears. Extensive field trials were carried out to re-evaluate the insecticide for codling moth control. It was demonstrated that azinphos-methyl is still as effective against this pest as when it was introduced in codling moth spray programmes in 1959. The cause of poorer control and higher infestation was traced to overall underspraying and underdosing. Azinphos-methyl can therefore still be recommended and used with confidence for effective and economic codling moth control in apples and pears.

Control of scab - A new range of sterol-inhibiting fungicides has recently become available. These fungicides have excellent corrective scab control properties. The formation of scab scars on leaves was prevented almost completely when the fungicides were sprayed within 72 hours after infestation had set in.

Sporulation on leaf scars was effectively halted when the fungicides were applied up to 16 hours after infestation had started.

Infestation of fruit was effectively controlled with penconazole when sprayed within 120 hours after infestation had set in.

Full utilisation of the sterol-inhibiting fungicides will contribute towards more effective and better economic control of scab on apples.

Bacterial leaf spot - The pathogen has now been identified. It has no symptoms and exists on all parts of apple and pear trees above the soil and on orchard weeds during the growing season.

The rough brown discolouration (russeting) on the surface of Golden Delicious apples is at present seriously harming the appearance of this cultivar. The use of gibberellin acid injections controls the rate of growth of the fruit in such a manner that the problem is minimised. This finding is of particular importance since it offers a solution to the problem of this harmful defect.

Peaches, plums and prunes

Pests - The periods during which peaches (including nectarines) and plums are susceptible to false codling moth infestation are directly related to the periods during which spraying against the pest is recommended in the case of early mid-season and late season drupe cultivars.

Such recommendations may now be made with certainty. This is of the utmost importance for the effective and economic control of the pest now that the false codling moth sex pheromone monitor system has been withdrawn from the market.

Diseases - Blossom blight/brown rot is at present one of the three most important diseases in drupes. It has now been determined that only one pathogen causes the disease in drupes in the South Western Cape and the Little Karoo. This refutes earlier suppositions that a second pathogen is involved.

Woolliness in peaches and nectarines can develop during the further ripening process after storage at low temperatures for periods of two weeks and longer. Research has showed that a long cold storage period and fruit harvested when it is still too green lead to a high occurrence of woolliness. In addition, fruit that has been stored at a higher temperature (e.g. 4 °C) is more susceptible to woolliness than fruit stored at a lower temperature (e.g. 0 °C).

Forced ripening - Prunes should ripen completely on the tree before being harvested for drying purposes. It is usual for a prune orchard to be picked approximately four times before all the fruit has been removed. It has been found in trials that spraying with the growth agent ethephon a week before the expected first harvest date results in 90 % of the fruit being able to be removed during the first picking. This results in a great saving in harvesting costs and makes mechanical harvesting much more attractive than it is at present.

Miscellaneous horticultural crops

Rooibos tea

The marketing of rooibos tea came to a standstill locally and overseas because of unacceptably high amounts of micro-organisms and the presence of *Salmonella*. Marketing was resumed after the product was made acceptable by means of ionic radiation. Transport costs to and from the radiation plant were exceptionally high, however, and an alternative method of treatment was sought. It was found that the exposure of dry rooibos tea-leaves to steam for two minutes makes the product microbiologically acceptable without affecting the flavour too much. Suitable equipment for this treatment is now being developed.

In the mean time, good progress is also being made with the development of an instant rooibos tea product, the microbiology and flavour of which comply with accepted norms.

Dates

The technique by means of which dates are multiplied by growing point culture has now been mastered. Since October 1984 suckers from selected date trees have been used for multiplication in this manner. The first plants are expected to become available in approximately two years. At present, virtually no propagating material is available locally and the cost of importing plants has become unacceptably high.

Viticulture

Breeding - In the case of table grapes, early seedless and early black selections are still being sought. Progress in this field has been so promising that various selections are at present being evaluated on a semi-commercial scale. This applies to the requirements of both the summer and the winter rainfall areas.

In the case of wine grapes, a large number of imported wine grape and rootstock cultivars has been transplanted in preliminary evaluation trials.

Rootstock cultivars - A total of 31 rootstock cultivars was fully evaluated at Vaalharts in respect of their susceptibility to *Meloidogyne* spp.

The rootstocks may consequently be classified as follows:

Resistant - Prosperi Super 99 Richter, Ramsey, 775 Paulsen, Dog Ridge, Freedom, Selection Opperheim No. 4, USVIT 24/10, USVIT 4-4. Berlandieri 13/5, 101-14 Mgt., 1103 Paulsen.

Moderately resistant - 99 Richter, USVIT 2-1. 143B Mgt., Solonis.

Tolerant - 1045 Paulsen, C. Metallica, USVIT 16-13-23 and USVIT 1-6

Moderately susceptible - Vivet 15, 110 Richter, 161/49C, USVIT 3-6. USVIT 3-5.

Susceptible - Castel 216/3, Malégue, 140 Ruggeri, Jacques, USVIT 8-7, USVIT 12/6/8, Grezot.

Rootstocks recommended for nematode-infested sandy soil are those that are classified as resistant or moderately resistant.

The wide variety of soil types and climatic conditions in the viticultural areas of South Africa makes the correct choice of rootstock essential but very difficult. For the purpose of more reliable recommendations, a number of locally available rootstocks were evaluated over several years in eight trials under different conditions. Chenin blanc, the most important white wine cultivar in South Africa, was used as the scion cultivar in all cases. Results, based on vigour and yield over several years, showed that the rootstocks 99 Richter, 110 Richter, 101-14 Mgt., Ramsey, 143-B Mgt. and 3306 C performed amongst the best in most of the trials, although their order of preference was not the same for all localities. Jacquez, until recent years the most popular rootstock in South Africa, performed poorly in most trials and cannot be recommended.

Nutrition - Results confirmed that drip

irrigation produces a better crop and better total mass of export quality grapes than micro-irrigation. In spite of an 11% reduction in water application with microsprays, it would still appear as if the quantity applied in this manner is an unnecessary luxury.

Clear indications were obtained that potash stock fertilisation in sandy soil is not effective and that potassium, like nitrogen, can be applied more successfully by means of the irrigation system.

Plant spacing - In an experiment to examine the interrelationship between yield, plant density and wine quality in the Pinot noir cultivar, it was found that the size of a vine root system is considerably diminished by high plant density, but that root density is increased. A steeper angle of penetration in the case of vines more narrowly spaced indicates that the roots of these vines penetrated deeper soil layers than those of vines more widely spaced.

Water requirements and cultivation practices - A great water saving of 110% was achieved with irrigation furrows in comparison with flood irrigation in broad beds, while the production, growth and quality of the grapes was the same for both irrigation methods. This was the result of a reduction in the irrigation cycle of irrigation furrows from 25 days to 17 days on sites where the entire area is irrigated. Additional irrigation shortly (10 days) before harvesting had no effect on the yield or composition of the grapes.

Vineyards under clear culture are still gradually deteriorating. Less shoot growth occurred on clear cultured sites than on those with a cover crop. It is expected that the poorer shoot growth will lead to a decrease in production in the future. Grass formed a more effective cover than vetch (legume).

Forced ripening - Ethephon spraying had no real effect on the ultimate sugar production of sultanina and therefore on the time of ripening, but it did reduce the total acid concentration, particularly when applied one week after change of colour. It was found that the region also has an effect on the reaction of sultanina to ethephon spraying. In some cases, ethephon spraying resulted in a significant improvement in the crop at Lutzville, whereas this was not the case at Upington. Indications are that ethephon results in a better quality raisin, but the reasons for this have not yet been determined.

Since ethephon makes no real contribution to forced ripening, spraying is envisaged with preparations that are known to accelerate growth at various physiological stages from budding to ripening. It is hoped that this will result in a cumulative forced ripening effect.

Vineyard pests - The leaf hopper, *Acia lineatifrons*, is a new pest that has been the cause of many problems in vineyards in the Western Cape since 1978. Two field trials were conducted to test a number of preparations for the control of leaf hoppers. Dusting sulphur was included in the trials because it was thought possible that the reduction in the use of sulphur in vineyards could be responsible for the origin of the pest. It was found in the trials that dusting sulphur is not effective against leaf hoppers, but good results were obtained with various other preparations in the control of the pest.

A bio-ecological study in the vicinity of Paarl on the Waltham Cross, Queen of the Vineyard and Barlinka table-grape cultivars showed that *Thrips tabaci* was the dominant thrips species on both the flowers and the leaves. The colonisation of racemes occurred only during the flowering period. The predacious mite, *Amblyseius addoensis*, was the most numerous natural enemy of thrips on leaves and could be one of the reasons for the population not having increased to economically detrimental numbers.

Oenology

Treatment of must - Various types of bentonite were retested for their effectiveness as an aid to settling in must, their effect on the fermentation process and wine composition and their ability to make wine protein-stable. Great differences in the effectiveness of the bentonites were noticed in respect of both the settling and the protein-stabilisation processes. Calcium bentonite produced less deposit, while sodium bentonite clarified the must or wine better. The fermentation process can be affected either favourably or unfavourably by bentonite, depending on the type of bentonite that is used.

Wine - The description of the *shades of colour* of Blanc de Noir wines created problems in the past, particularly for legal purposes. This matter was investigated and particularly interesting data were obtained. Commercial wines were stored over a period of 10 months at 0 °C, 10 °C, 20 °C and 30 °C and judged and analysed every month with the aid of a spectrophotometer. A panel of experienced judges also used a special judging chart for colour descriptions to evaluate the wines. By combining the readings from the spectrophotometer and the data from the chart, the researcher is now able to describe the shade of colour of a wine.

The limited *shelf-life* of some white wines creates problems for the marketer of wine. Preliminary results indicate that there is a connection between certain aldehydes and this problem. This creates the possibility of developing stability tests to predict the shelf-life of wines.

Terpene concentrations - Total free and bound terpene concentrations were analysed in grapes of various cultivars from various regions. Total bound terpene concentrations varied between 84% and 92% for muscat cultivars (such as Muscat d'Alexandrie and Muscat de Frontignan), 50% and 89% for aroma-related cultivars (such as Weisser Riesling, Gewürztraminer and Bukettraube) and 28% and 59% for non-muscat cultivars. This pool of potential flavour is of great importance since most cultivars in South Africa lack sufficient aroma and character in their wines.

Certain must treatments were applied in an attempt to increase free terpene concentrations in wines and to strengthen the aromas of Weisser

Riesling and Bukettraube. A press and skin contact were used to increase free terpene concentrations. Heat treatment was applied to release bound terpenes through the hydrolysis of sugar-bound terpenes. The press showed little significant increase, skin contact showed a moderately significant increase and heat treatment showed a highly significant increase in terpene concentrations and the general quality of Weisser Riesling and Bukettraube wines.

The effect of ripeness on terpene concentrations was also tested and results showed an increase in terpene concentration in accordance with an increase in the ripeness of Weisser Riesling, Bukettraube and Muscat d'Alexandrie grapes in general.

Retarded fermentation - Research on retarded fermentation led to the use of new yeast races and technology. This was so successful that fermentation problems during the making of white wine in 1985 occurred only in very exceptional cases.

Dried wine yeast - Six lots of South African-dried wine yeasts, a dried baker's yeast and four imported dry wine yeasts were compared with one another in respect of microbiological and keeping quality. All the yeasts were of the *Saccharomyces cerevisiae* race.

Total microbic counts, total yeast counts, total bacterial counts, sporulating bacterial counts and lactic acid bacterial counts were carried out on the same basis for both the local and the imported yeasts. The imported yeasts generally contained lower concentrations of wild yeasts and *Enterobacteriaceae*.

Optimum storage temperatures for dried yeasts are 0 °C and 4 °C. At 15 °C a slight decrease and at 25 °C a noticeable decrease in viability occurred over a period of six months.

Cellar equipment - Two wine presses, namely the Diemme T10 and Vaslin CEP1000, were tested under commercial conditions and compared with a static Bucher separator at a co-operative wine cellar. It was found that destemming before pressing improves the quality of wine from certain cultivars and press combinations.

No statistical proof could be found that the addition of the musts of a first and second press to free-run must has a detrimental effect on the quality of wine compared with wine that is made from free-run must alone. This holds out the possibility that larger volumes of good-quality wine per ton of grapes can be made if these presses are used instead of a static separator.

Citrus and subtropical crops

Citrus

Cultivar studies - An evaluation of five navel selections showed that the Bahianinha selection performs best at Addo and that the Buffelspoort navel does best at Citrusdal. Because of the prevalence of fruit cracking and tough rag the Lane Late navel cannot be recommended for commercial cultivation. In an evaluation of 12 early and late navels, it was found that the earliest selection, Newhall, is ready to be picked in the Eastern Transvaal as early as the end of February. Nieuwoudt and Robyn can remain on the trees and still be of export quality until September and October, respectively, at Citrusdal.

Citrus Improvement Scheme - A total of 54 citrus selections, representing 10 commercial cultivars, are at present certified as being virus-free and cross protected against tristeza. Thirty selections have already been declared to be horticulturally true to type and 13 of these were made available during the year under review to nurseries participating in the South African citrus improvement scheme.

Tissue culture - The technique of the *in vitro* cultivation of the embryos of citrus is being applied as a matter of routine with the primary aim of obtaining embryogenic callus. Embryogenic callus was started in 10 different cultivars from the nucellus tissue of four-week old fruit. Success has already been achieved in obtaining callus and embryos from rough lemon and Midknight sweet orange protoplast cultures.

In vitro **selection** - In the selection for brack tolerance, NaCl-tolerant cell lines were observed in callus cultures from the Cleopatra mandarine. The stability of these cell lines must, however, still be determined.

Growing point grafting - The technique of growing point grafting is already used regularly for the elimination of viral diseases and the production of disease and pest-free citrus trees.

Pests - Methods of controlling the false codling moth on citrus that can be used with the range of integrated pest management techniques, were investigated. These include ecologically-sensitive insecticides that can reduce damage by up to 90% and that do not affect non-target natural enemies. New cultivar selections of the navel orange were examined and less vulnerable types were identified. Experimental releases of false codling moth egg parasites showed that levels of parasitism can be increased.

Citrus rootstocks that are resistant to the citrus nematode, *Tylenchulus semipenetrans*, can be used locally with good results if *Xiphinema brevicolle* can be controlled successfully. Three nematocides, namely fenamiphos, carbofuran and aldicarb, controlled *Xiphinema* for an entire season.

Diseases - Considerable attention was given to the phenomenon of the development of benomyl-resistance by the black-spot pathogen with a view to the development of alternative control strategies with a minimum disturbance to the biological control of insects.

The selection of mild strains of tristeza is progressing well, as is the investigation into pathogens that induce dwarfing in citrus.

Pineapples

Four new promising clones of Smooth Cayenne were isolated for further evaluation and

propagation. A number of Smooth Cayenne plants, which appear to have greater tolerance to *Phytophthora* (root rot), and plants that thrived in eelworm-infested soil are being multiplied for further evaluation under local conditions.

Plant multiplication - With a view to the production of pineapple plants that are free of diseases and pests, a study was undertaken on the *in vitro* technique of multiple shoot formation to increase the mass of rooted plants. This technique makes it possible, amongst other things, to cultivate plants that are free of root diseases.

Pests - The insecticide isazofos as a 500 g/ℓ (ec) has now been registered as a replacement of dieldrin and HHDN for the control of white grubs and black maize beetles in pineapples.

Methyl bromide fumigation of pineapple planting material effectively sterilised the plants of all pest species, although it had some adverse effect on the growth of plants exposed to longer periods of fumigation.

Leathery pocket disease was well controlled with endosulfan sprays, and an ant bait has shown very promising results.

With a view to the biological control of pineapple mealybug in Zululand, about 1 000 *Euryrhopolus propinquus* wasps were released. A successful laboratory breeding programme for these wasps is under way.

Nutrition - Analysis norms for the correct feeding of pineapple plants are now available. Using these norms, the feeding status of a pineapple planting can be evaluated as early as six months after planting.

Bananas

Tissue culture - Protoplast cultures are obtained relatively easily from the growing tips of banana stems but it has not yet been possible to obtain callus. Indications are that callus can develop from cultures of flower growing tips.

Pests - New methods of applying nematocides to bananas that could be more effective and save the farmer some costs are being investigated. Promising results have already been obtained with the application of a granular nematocide to the cut-off pseudostems of the plant crop and with the application of a nematocide to the basis of the leaves of the ratoon crop.

False Panama wilt - No fungi associated with False Panama wilt in bananas could be isolated. A strong connection between root knot nematode and False Panama wilt was found, however, and the effect of nematocide on the syndrome is at present being investigated.

Diseases - It has been established that, apart from Natal and the Burgers Hall area, all other areas are free of Panama wilt disease.

Cold storage - Serious ripening and spoilage problems in bananas that hang too long were investigated and an earlier harvesting date was recommended. In respect of a ripening problem later in the season (November) in fruit with the inherent characteristic of not ripening, it was recommended that poor winter bunches be cut off in future. This would be of great benefit to the producer or ripener and would entail little loss.

Avocados

Nutrition - In a field trial on a Doveton soil series with a pH (water) of 5 and exchangeable aluminium of 94 and 146 mg/kg in the top and subsoil, respectively, liming dramatically increased the yield of avocados. The best yield was obtained where 5 tons/ha of dolomitic lime or calcium silicate was applied for four consecutive seasons.

Water requirements - Moisture stress early in the development of the avocado fruit has a detrimental effect on the browning potential and ripening of the fruit. Optimum irrigation was at 55 kPa.

Pests - A new pest, the coconut bug (*Pseudotheraptus wayi*), was found on avocados in South Africa for the first time. It causes unsightly blemishes on the skin, which makes the fruit unsuitable for export. The exact distribution of the insect is not yet known and no preparation has as yet been registered for the control of the insect.

Diseases - The investigation into the tolerance of the avocado for *Phytophthora cinnamomi* has virtually been completed. The toxin associated with the syndrome has been isolated, and the chemical/physiological mechanism involved in the tolerance has been determined.

Growing tip grafting - With a view to the production of avocado plants that are free of diseases and pests, Citrus and Subtropical Fruit Research Institute researchers succeeded in applying growing tip grafting successfully, in contrast with researchers abroad, who have been working on this problem for years without success. Shoot tip cultures are established and multiplied successfully in a medium but it has not yet been possible to induce the formation of roots.

Growth regulators - Successful radio immune tests were developed to monitor abscisic acid, indoleacetic acid and cytokinine in avocado tissue. The critical role of growth regulators, produced in the seed, in the growth and development of the fruit was proved.

Litchis

Post-harvest treatment - Because of refusal from abroad to accept South African sulphur-fumigated litchis, an investigation was instituted into the sulphur content of the fruit. The fumigation process resulted in a measurable (but not visible) increase in total sulphur on the skin. The amount was, however, smaller than is normally found in a wide variety of edible products such as meat, fish, chicken, nuts and beans. The sulphur fumigation process therefore does not affect the edibility of litchis.

Pecan nuts

Pests - Various preparations were tested for the control of the pecan stem borer, *Eulophonotus myrmeleon*, a moth that attacks the trunks of pecan-nut and macadamia-nut trees in South Africa. Good control was obtained with fenvalerate, carbaryl and cyfluthrin.

Granadillas

Tissue culture - Callus with organogenic potential was obtained from the leaf tissue of the wild granadilla (*Passiflora caerulea*), while the most suitable callus from the commercial granadilla is obtained from the pericarp (*P. edulis*). It has not yet been possible to induce organogenesis.

Growing tip grafting with a view to the production of granadilla plants free of diseases and pests has already been done with partial success, but it has not yet been determined whether it is in fact possible to eliminate viral diseases.

Tea

Quality evaluation - A study of biochemical criteria for the evaluation of the quality of tea has led to a high polyphenol oxidation activity and the accompanying increase in theaflavin in the leaves of MT12 tea clones being used as a reliable criterion for high-quality tea. It is at present being used successfully in the selection of improved tea clones.

Processing procedures - With the use of the biochemical criteria, it was possible to determine that the quality of tea can be improved significantly by picking the tea by hand, rolling it four times in a roller mill, fermenting it for 30 to 180 minutes and then drying it for 20 to 30 minutes in a drying-oven at an initial temperature of 96 °C and a final temperature of 65 °C.

Ginger

Pests - Ginger is highly susceptible to the rootknot nematode species *Meloidogyne javanica* and *M. incognita*. Not only are plant parasitic nematodes responsible for serious crop losses but the storage life of rhizomes on the fresh market is also affected adversely. Effective nematode control could be demonstrated with split applications of fenamiphos 10 % granules, which led to a considerable increase in yield.

Nematode-free ginger propagation material is virtually unavailable to the ginger industry. The possibility of cleaning ginger rhizomes to remove rootknot nematode prior to planting was investigated. Seed pieces dipped in aqueous solutions containing 40 % fenamiphos resulted in good nematode control and growth responses. No phytotoxicity was observed, and further trials are being planned.

Vegetables

Tomatoes

Good progress is continuing to be made with the tomato breeding programme, and lines with a high resistance to various combinations of diseases such as *Fusarium* Races 1 and 2, *Verticillium*, bacterial canker and bacterial wilt are now available. As regards both table and canning tomatoes, lines with a combination of resistance to tomato spotted wilt virus, *Fusarium* Race 1 and *Verticillium* are now also available. Canning tomato breeding lines with a higher content of total soluble solids have also been developed.

The American leaf miner has become a serious tomato pest in the Transvaal Lowveld and the Pongola area. Two species of the leaf miner parasites were imported from the USA with a view to combating leaf miner populations on wild hosts and weeds. The parasites have already been released in the vicinity of Tzaneen and preliminary results are promising. A chemical preparation for the control of the pest has also been registered.

Onions

An early line, U81-3, with a round shape, brown colour and better keeping quality is at present being marketed as a new cultivar. Thirty kg of seed from the improved source of this onion as well as breeder's seed is being produced at present. Various cultivars from abroad have been evaluated in order to identify material for use in local breeding programmes.

The effect of seed bed practices on crop performance is being investigated and indications are that pruning practices in the Western Cape lead to smaller bulbs and reduced yields.

It was found that pink-root resistant cultivars from the USA are susceptible to the local race of the organism that causes pink root in onions. These findings are important because they indicate the existence of various races of this organism.

Green peas

Six lines that are particularly resistant to powdery mildew have been selected for possible use as new cultivars. The breeding programme in the Southern Cape for resistance to *Ascochyta* leaf diseases and the breeding of semi-leafless peas are being continued.

Dry peas

The breeding programme for dry peas has produced an early breeding line with a semi-leafless growth habit. This line fared well in trials compared with the cultivars Miranda and Finale.

Pumpkins

A pure breeding line of the species *Cucurbita moschata* has provisionally been approved as a new cultivar. The search for a boer pumpkin (*C. maxima*) with a bushy growth habit instead of a vine has produced breeding lines with a good crop and medium-sized vegetables.

Spanspek

A final selection is being carried out on a yellow and cream spanspek with a round shape that should be suitable for export by air. Further in-breeding and evaluations were carried out on the Honey Dew spanspek with a view to selecting and combining the best progeny in order to obtain an improved seed source. An improved source of Green Elche is being evaluated.

Virological studies have shown that the Moroccan race of the watermelon mosaic virus is the dominant race in South Africa and that it occurs in all four provinces. Resistance to this race has been found in certain wild *Cucurbita* species.

Cauliflower

Early, open-pollinated breeding lines have been developed that compare well with early F1 hybrids as regards growth vigour, head and quality. These lines are better than existing open-pollinated cultivars and are being considered for marketing.

Cultivar trials at Roodeplaat have shown that the new F1 hybrids, Spring Snow, White Dove, and Igloo, produce good results.

Green beans

Various breeding lines with speckled and white seeds with a good yield potential and a relatively high degree of resistance to both halo blight and brown rust are available. The release of a few of these lines as new cultivars is envisaged.

Carrots

Good progress was made with the reduction in the percentage of deviant types in Cape Market and Chantenay Karoo. The occurrence of green shoulders and wide core in Cape Market could not be reduced. Cultivar trials confirmed that the quality of carrots is lower during summer than during the cooler winter months.

A study of the water consumption of carrots and the effect of moisture stress is being carried out at Roodeplaat with a view to irrigation scheduling and water-saving.

Flowers and ornamental plants

Proteas

Representations were made by the protea industry for the release of a number of new winter-flowering *Protea* and *Leucospermum* cultivars. In spite of the fact that these particular cultivars flower in winter when proteas are abundant, they are of such high quality that the industry regards them as improvements on those at present available to the industry.

Insects in proteas remain a big problem when flowers are exported. Results show that insecticide in the form of gas, with which the harvested flowers can be treated before packing, controls insects very well. Preliminary results show that a more than 99 % success rate is achieved after three hours of exposure to the insecticide.

Flowering bulbs

Progeny was obtained from crossings between *Ornithogalum thyrsoides* and *O. maculatum*, the embryos of which had previously aborted because of incompatibility problems, through the use of embryo culture. The embryos of such crossings were removed from the flowers under a microscope four days after fertilisation, dissected and further cultivated in a medium into mature plants. The first of the seedlings will flower this year. It is hoped that this technique will make it possible to obtain orange-coloured cultivars with the qualities required for cut-flower purposes.

Good progress is being made with the *Gladiolus* breeding programme to incorporate fragrance in the modern *Gladiolus*. A large number of seedlings with the flower characteristics required for cut-flower purposes and with a pleasant fragrance is at present being evaluated by the industry.

The flowering bulb scheme for the provision of improved plant material to the industry was amended. This means that now only small quantities of disease-free material are provided to the industry and that the industry undertakes further multiplication itself.

Cut flowers and pot plants

The outbreak of the American leaf miner *Liriomysa trifoli* that occurred a few years ago on the premises of chrysanthemum growers is now completely under control. The insect was exterminated by means of new methods of control.

The rose plant improvement scheme was further expanded. Two rose growers established foundation sources for rose root stocks. Although the plantings are still too young to meet all the demands of the industry, good progress is being made and it should be possible to provide the industry with all the required material within two years.

During 1984, the Institute received 49 new rose cultivars from the industry for evaluation and disease purification. Under the scheme, the industry was supplied with 9 400 eyes from disease-free cultivars and 153 000 root stock cuttings.

Tuber crops

Potatoes

The biggest problems in the potato industry are still the low production per unit of area, poor quality and the poor keeping quality of potatoes from some areas. The main reasons for this are changeable dry-land production and a shortage of cultivars with a tolerance for high temperatures.

Follow-up work on the quality and keeping quality of tubers showed that calcium not only plays an important role in the appearance and structure of the cell walls of the tuber but also has an important effect on the organic acid content of the tuber. Acid soils have a serious detrimental effect on quality and keeping quality.

The possibility of applying calcium as a leaf fertiliser was investigated with the aid of radio-active calcium. It was found that the calcium is taken up by the leaves of the potato plant and translocated to the tubers. The practical application of this principle is at present receiving attention.

Breeding

In the potato breeding programme, attention is at present being focused on the improvement of quality and keeping quality, the development of early cultivars with a higher yield, and the improvement of resistance to specific diseases and tolerance for heat and drought.

A commercial evaluation scheme was started under which advanced breeding lines are given to approved farmers. The aim of this is to evaluate the breeding lines when cultivated on a larger scale. Three advanced breeding lines, namely 71-33-11, 73-75-9 and 72-49-7, have already been used under the scheme. The 71-33-11 line is an early clone with a higher yield potential than the Vanderplank cultivar and is eminently suitable for cultivation in cooler regions, while the 73-75-9 line is a medium-short grower and performs well in all regions. The 72-49-7 line is a tall grower of good quality with a higher yield under dry-land cultivation in the Eastern Transvaal Highveld.

A soil storage trial showed that these lines have a longer keeping quality than Up-to-Date and BP1 under Highveld cultural conditions.

Considerable progress was made with scab and dry-rot resistance breeding. A large number of clones with greater resistance than local cultivars are already available and are at present being evaluated for agronomic acceptability.

Diseases and pests - Field trials in respect of the occurrence of stem canker and black scurf, caused by *Rhizoctonia solani*, have long confirmed that black scurf infested tubers are the primary source of infection. Fungicides that control the disease satisfactorily have now been registered and during the testing of new preparations, two were found that give excellent control of *R. solani*. One of these will be registered shortly.

A survey of the occurrence of bacterial wilt was carried out during the past year. It was found that biotype 4 of the causative bacterium *Pseudomonas solanacearum* was responsible for the infection of tomatoes in all cases and that biotype 1 was present in the majority of potato samples that were investigated. Both plant species are susceptible to both biotypes but the distribution of the biotypes is important with regard to the possible release of resistant breeding lines.

Tuber moth in lands is being controlled satisfactorily but remains a problem in tubers after harvesting. Significant losses of seed potatoes are experienced annually during storage. Table potatoes for export infested with tuber moth are not accepted in certain countries. In cold storage trials with artificially infested tubers, it was found that 80 % to 100 % of the eggs, larvae and pupae of the insects were dead after 12 weeks at 3 °C to 4 °C.

Sweet potatoes

Thirty entries were selected as parents for a breeding programme. Breeding lines with a yield potential the same as or higher than that of standard cultivars were identified and evaluated at outstations. Various lines are being evaluated in co-operation with freezing and dehydration companies and starch manufacturers.

The results of a plant population trial show that a spacing of 1 x 0,6 m with double rows gives the highest yield of sweet potatoes of the desired size. If plant material is available more cheaply and freely, a spacing of 1 x 0,4 m with double rows can be used for the production of smaller sweet potatoes for supermarkets.

PLANT PROTECTION RESEARCH

National Collection of Insects

Specialised taxonomic studies

Parasitic wasps - Studies on the African parasitic wasps of the superfamily Chalcidoidea are continuing, with special emphasis on the Encyrtidae and Aphelinidae, which are two of the groups of extreme importance to the biological control of injurious insect pests. A large number of routine identifications of parasitic wasps were undertaken for research workers from various institutions in the Republic, SWA, Zimbabwe, Réunion, the Republic of the Congo and Senegal. Three taxonomic papers on African parasitic wasps were published, including an illustrated guide to the parasitic wasps associated with citrus pests in South Africa. Collecting trips were undertaken to the south-western Cape, Natal, the eastern Transvaal and South-West Africa, during which several thousand specimens, representing all the parasitic wasp families, were collected. The collection remains one of the biggest of its kind.

Neuroptera (lace wings and allies) - Accessions of the southern African fauna of this insect group

increased to over 6 000. This is the most comprehensive reference collection available. Field trips were undertaken to various parts of the Transvaal to collect specimens, and contact was established with persons in neighbouring states, who now regularly donate material to the National Collection. The first paper in a series, which will revise the southern African Myrmeleontidae, was published. In addition, two papers were presented at an international symposium on Neuropterology during the 17th International Congress of Entomology in Hamburg, West Germany.

Aculeate Hymenoptera - Both a revision of work on the Anthophorine bees and a catalogue of the African carpenter bees are nearing completion. The collections have been expanded by about 6 000 bees and 3 500 wasps and now stand at about 18 000 specimens of bees and 29 000 wasps. This material was collected during field work in the Transvaal and western Cape. The reference collection has recently become one of the largest of its kind in Africa.

Curculionoidae (weevils) - Research on weevils has progressed from extensive field surveying to a detailed study of the Eremninae, a group that includes a number of important agricultural pests. The first phase of this study, a taxonomic revision of the various genera, is nearing completion. The collection of weevils has been expanded and now contains some 35 500 specimens. The literature accompanying this collection now includes several thousand valuable papers on the subject.

Aphids and scale insects - The collection of aphids now includes 580 samples in alcohol and 5 000 slide-mounted specimens, representing almost all the South African species, with information on their host plants. A host-plant index of South African aphids will be published soon and an illustrated guide to the local aphid species is being prepared. Taxonomic work on scale insects was also resumed, and this has enabled the section to provide an identification service in respect of these pests. Apart from the scale insects, there was a great demand for the identification of aphids from institutions throughout the country.

General collection of insects - During the year many thousands of specimens, representing most of the major orders and families of insects, were collected for the general reference collections of the National Collection. These collections, which have become the most extensive of their kind in Africa, are of extreme importance in providing basic entomological information to the scientific community. Some 2 000 routine identifications were carried out, and public enquiries pertaining to many aspects of entomology were dealt with. A list of the insects associated with forestry in South Africa was compiled and the curation, updating and rearrangement of the Lepidoptera collection continued.

Biological and integrated control

American bollworm - Studies on the population dynamics and feeding behaviour of American bollworm on cotton were continued in order to determine economic threshold values for spraying against this pest complex of cotton. It has become apparent after several seasons that the customary five to eight sprayings can be reduced to two to three. Larval counts are a more reliable yardstick for measuring the pest population than egg counts, which are influenced by factors such as the incidence of egg parasites and other natural enemies and overhead spraying.

Surveys of the indigenous natural enemies have confirmed that parasitism of American bollworm larvae is low and that parasitism is inadequate for the effective biological control of the pest. A culture of imported parasites has already been established in the laboratory for release during the 1985/86 season.

Stalk borers - Exotic parasites of the grain sorghum stalk borer, released during the past season, have not yet been recovered. Laboratory cultures of three other imported kinds of parasites are being multiplied at present for release during the coming season. Imported natural enemies of the sugar-cane borer will in future be tested against the grain sorghum stalk borer as well.

Pests of spineless cactus - Effective control of the prickly pear moth can be obtained with several poisons, apart from those previously registered for this purpose. A limiting factor is that all the preparations have to be administered before the larvae have tunnelled into the cactus leaves. Research therefore continues to be aimed at developing systemic preparations that may be easier to apply or that will kill the larvae in the leaves. The same preparations should preferably be effective against sucking cochenille as well, and techniques to evaluate preparations against this pest are being investigated.

American leaf miner - Research on the biological control of the American leaf miner, a serious pest of flowers, tomatoes and other horticultural crops, was undertaken in co-operation with the Horticultural Research Institute. Indigenous natural enemies were evaluated in field surveys and two imported parasites were released.

Imported natural enemies of insect pests - Seventeen consignments of natural enemies of pests of citrus, forest trees, horticultural crops, sugar-cane and field crops were imported under quarantine conditions and released to various industries. The imports were arranged for the benefit of several Departmental and private bodies.

Cotton mites - A trial was carried out at the Hartebeespoort Research Station to investigate triazophos sprayings for the control of red spider mite at various periods in the growing season of the cotton plant. On the basis of the incidence of mite populations during the season, it would appear that early spraying is the most beneficial.

Insects in stored products

It was established that the gas retention capacity of local silo bins is good despite a pressure retention capacity that compares very poorly with

the standard stipulated in Australia. Nevertheless grain, especially wheat, is often reinfected with insects in this country shortly after it has been fumigated, as if the fumigation were not effective. It appears, however, that insects that left the grain during the fumigation and then returned after the gas had dissipated are responsible for this phenomenon. Sealing the silo bin and so making it impossible for insects to reach the grain should solve the problem.

Bee research

The value of honey-bees as pollinators of agricultural crops continued to be studied. More intensive pollination of sunflowers by honey-bees could raise fruit set by 22%. However, the plants compensate to some degree for poor fruit set by a higher seed mass.

High infestations of the eucalyptus nectar fly were again widespread and the nectar flow was correspondingly lower. In the coastal areas of Zululand an unknown rhinoceros beetle made its appearance as a pest of beehives.

Forest and timber insects

The imported parasite of the black pine aphid, *Pauesia* sp., is now undoubtedly established in this country. The parasite has spread very rapidly and at present occurs throughout the entire summer rainfall area. Although it is still too early to say to what extent the parasite contributes to the control of the black pine aphid, chances of success appear promising. Since the first releases of the parasite in the Eastern Transvaal in 1983, no significant outbreaks of the pine aphid have occurred in the area.

Further cases of pine trees having been attacked after pruning and ringbarked by the European bark beetle *Orthotomicus erosus*, occurred in the Eastern Transvaal. In all these cases the trees were pruned in summer and the attacks coincided with fungal infections in the pruning wounds. This problem is potentially serious and the matter is receiving intensive attention.

The eucalyptus tortoise beetle, *Trachymela tincticollis*, again caused severe defoliation of trees in the Western, Southern and Eastern Cape. The infestations did not spread further in the direction of the Transvaal and Natal. What is causing concern, however, is that *Eucalyptus grandis*, the most important bluegum species in the country, and several of the new species being grown experimentally, are also defoliated by the beetle.

In co-operation with the National Timber Research Institute, several samples of timber were exposed to timber-eating insects during the year to test the efficacy of potential preservatives. Extension work on all aspects of forest and timber entomology continued and eight pamphlets on forest insects were completed.

Locust ecology

Altogether 12 districts in the Free State, Transvaal and Cape Province produced incipient outbreaks of the African migratory locust during the year. These occurred, principally, in maize in the autumn of 1984 and in wheat in spring and early summer. Field investigations in these areas continued so as to determine the causes of outbreaks and to work out the annual cycle of the locust in the summer grain areas. Early rains in August 1984 favoured early build-up and recruitment of locusts, which dispersed into the newly sown maize and led to widespread and sustained multiplication of locust populations in this crop during the summer of 1984/1985. However, late ripening of the maize discouraged concentration on the crop headlands in autumn but led to an enormous population build-up in many districts with outbreaks again likely in early winter.

Numerous spraying trials for developing a suitable ultra low volume spraying technique for controlling locusts with the aid of helicopters were carried out against hoppers and adult swarms of the African migratory locust. For the second time in recent years a swarm of red locusts appeared in Swaziland in May 1984 and was sprayed before it could enter the Transvaal. Aerial application onto sugar-cane by the Departmental helicopter using fenitrothion produced excellent control. Spraying was carried out jointly with the co-operation of the Swazi Ministry of Agriculture and Co-operatives.

Harvester termites

During the year 937 colonies of termites were established in the laboratory so as to carry out research into the efficacy of certain commercial baits available for harvester termite control.

Economic zoology

National Collection of Nematodes

The collection of nematodes was extended to 21 570 preparations, representing about 79 900 specimens. During the year under review 1 343 soil and plant samples were examined; these included 128 samples examined for farmers and other private persons and bodies, 360 flowering bulb and seed samples, 720 ornamental plant samples for the Division of Plant and Seed Control, and 135 samples taken during survey trips. The genera *Alrina, Orina* and *Elaphonema* are being studied and several new species are being described.

Rootknot nematodes (*Meloidogyne* spp.) - At present 97 pure cultures of the four common rootknot nematode species are being bred in the greenhouse. The reference collection contains 1 880 preparations at present.

Soil and root samples, mainly of vegetable crops, were taken on 94 farms in the Nelspruit

district, the Tzaneen district and the Stellenbosch district.

Taxonomic studies with the aid of the light and scanning electron microscopes were continued with the object of identifying the physiological races of *M. incognita* and *M. arenaria*. Two species - one from pecan-nut orchards at Nelspruit and one from indigenous vegetation on the Natal South Coast - are being described.

National Collection of Arachnida

Accessions of mites amounted to 332 and those of spiders to 710. A total of 784 identifications of mites were carried out, and the areas from which mites were identified included Zimbabwe, Mozambique, Israel, the Netherlands, Iran and the Cape Verde Islands. A total of 1 359 identifications of spiders were carried out during the year under review.

Plant Pathology/Microbiology

Mycology

National Fungus Collection - During the past year the mycology herbarium was renamed the National Fungus Collection and, in addition to the existing dried specimens of fungus material, this now includes a live collection of cultures. This step was taken to meet the increased demands being made of fungus taxonomists and also to supply plant pathologists with live cultures. An integrated identification service is now offered by the mycology unit to interested persons in South Africa; 400 identifications have already been carried out for overseas bodies.

Toxigenous fungi on stock feed - Sixty-one specimens of stock feed were examined during the past year for the presence of toxigenous fungi. The sharp increase in *Aspergillus flavus* continued.

Sclerotinia sclerotiorum - Attempts to control this organism, which has 240 host plants, were continued through the chemical treatment of the seed and plants and natural hyperparasites. The chemical treatment of seed produced promising results. Stratification by means of plastic tarpaulins is a promising treatment that destroys between 90 and 100 % of the sclerotia up to a depth of 5 cm if the tarpaulins are left on the ground for six weeks. Field trials with the hyperparasite *Gliocladium verens* also produced good control.

Fungal diseases of pasture legumes - Cultivars of annual *Medicago* spp. were tested under greenhouse conditions for resistance to *Colletotrichum* crown rot, caused by *Collectotrichum trifolii*, and seedling dieback, caused by *Fusarium avenaceum* and *Fusarium graminearum*.

Borung, Paraggio and Paraponto were resistant to crown rot, but the various cultivars showed no clear differences in their response to seedling dieback, except for Robinson, which showed significantly less post-emergence dieback than other cultivars.

Disease assessment of imported lucerne cultivars was continued in 10 field trials conducted in various parts of the country.

A survey of *Phytophthora* root rot of lucerne in the Transvaal has been completed. The disease was present in all the sampling areas. The survey has now been extended to the Cape Province.

Phytophthora cinnamomi - Sporulation of *Phytophthora cinnamomi* occurred more frequently at two sites in fields of cultivated pincushions than at a site in the adjacent fynbos. Moisture and temperature requirements for sporulation were determined in the laboratory and these results showed that optimum conditions for sporulation occurred more often at the cultivated sites than at the fynbos site.

The role of *P. cinnamomi* in the decline and death of stinkwood and other indigenous forest trees is being investigated further.

Bacterial diseases

During the year under review 121 specimens, representing 49 different kinds of plants, were investigated for bacterial diseases on behalf of 35 persons and bodies. The investigations revealed that imported seed of *Capsicum* sp., *Brassica* sp. and *Pisum sativum* was infected with bacterial diseases, some of which had not previously been observed in this country, such as a biotype of *Xanthomonas vesicatoria* on green peppers.

During the past year 425 bean samples were tested for disease in the laboratory. Disease-free seed of all green bean and drybean cultivars except for kidney beans is now available to the farmer. The success of the disease-free bean seed scheme confirms the efficacy of the process by which the seed is freed of pathogens.

Good progress was made with the isolation of races of *Agrobacterium radiobacter*, which form agrocins that suppress crown gall bacteria in grapevines. This is the first known case in which races with potential for the control of grapevine crown gall have been isolated.

Nitrogen fixing - The selection of the most effective *Rhizobium* races for fixing nitrogen in legumes grown in South Africa was continued, and these races were supplied to legume inoculant manufacturers. The quality of inoculants was continuously monitored and this ensured that local inoculants are still among the best available. 222 inoculants for 73 different crops were supplied to researchers for experimental purposes. Inoculants were manufactured for new legumes that have potential for utilisation in agriculture.

Virus diseases

Studies showed that at least three viruses occur in the vine leafroll disease complex. Antiserum against one of the virus components - known as

grapevine virus A - has already been prepared and this makes serological tracing of the virus on a limited scale possible. This takes a single day, whereas the present field tracing procedure takes from two to four years.

Two new graft-transmissible virus-like diseases have been found in local grapevine material. Although it is latent in certain cultivars, including Cinsaut, the disease known as Shiraz disease causes major deterioration in Shiraz, Colombar, Gamay and Tinta Barocca. The importance of this disease in the deterioration of table grape plantings is being investigated at present. Grapevine vein necrosis, a latent graft-transmissible disease, has been traced in a few local grapevine sources. The importance of this disease is being investigated.

Cherry little cherry - A graft-transmissible virus-like disease has been traced in an imported cherry cultivar for the first time. The disease is of great economic importance in cherry plantings in North America, where it spreads naturally. The necessity of applying quarantine control has again been confirmed by this finding.

Indications have been obtained that apple mosaic is seedborne. Up to 10% of a seedling population is infected. In economic terms apple mosaic is one of the most important virus diseases of apples and Golden Delicious is heavily infected.

Apple stem grooving virus, which is common in imported pome cultivars, has recently been identified as one of the most important causes of the progressive deterioration of Packham's Triumph pear plantings in the Western Cape.

Diseases of forest trees

A preliminary survey of the fungal pathogens associated with pine root feeding beetles has been conducted. Numerous pathogens, including both known and undescribed species, were found.

Weeds research

Biological control of weeds

Lantana - The redistribution of leaf-mining beetles along the Natal coast and in the Transvaal Lowveld was continued. Populations of the established sucking insect *Teleonemia scrupulosa* were not excessively high, but this insect, in combination with the two leaf-mining beetles *Uroplata girardi* and *Octotoma scabripennis*, exert so much pressure on lantana at Margate that the plants are continuing to deteriorate. The sucking insect *Leptobyrsa decora* and the leaf-mining fly *Calcomyza lantanae* were also released. *C. lantanae* has survived the second winter at La Lucia, to the north of Durban, and at Margate. At Margate, especially, fly numbers and leaf damage were high and it can safely be assumed that this fly is well established.

Jointed cactus - Further releases of the jointed cactus moth *Nanaia* sp. n. have been made in the Eastern Cape and in Natal. So far the insect has failed to establish and it is unlikely that it will ever play a significant role in the biological control of jointed cactus. *Mimorista palchellalis*, however, still survives at several release sites, from which it has subsequently spread to surrounding infestations, but densities are low so that its contribution to control remains insignificant.

Sesbania - First releases of the stem-boring weevil *Neodipplogrammus quadrivittatus* and the seed-feeding weevil *Rhyssomatus marginatus* were made during the summer of 1984/85 in the Eastern Cape and in Natal. Indications are that both insects have established.

Monthly surveys on the bud-feeding weevil *Trichapion lativentre* were conducted to monitor its progress and spread. Seed production of *Sesbania* plants was reduced from 50 to 100%.

Satansbos - Another release of the fruit feeding moth *Frumenta nephelomicta* was made. At this stage it is, however, not possible to say whether the insects have become established. Further releases are contemplated.

Alien invasive weeds in the southern and south-western Cape - With hakea fruit weevil, *Erytenna consputa*, now widely established, work has been started on the incorporation of this and other biological control agents, such as the pathogenic fungus, *Colletrotrichum gloeosporioides*, into integrated weed control programmes in specific catchment areas.

Consistently high reduction in the seed production of the long-leafed wattle, *Acacia longifolia*, by the bug-galling wasp, *Trichilogaster acaciae-longifoliae*, has been confirmend at a variety of sites. Dispersal of this insect is excellent, and galls are commonly found a few kilometres from release points. The wasp has established at all 60 sites where it was released last year, and during the year 50 new releases were made in the southern Cape.

The seed-attacking weevil, *Melanterius ventralis*, was shown to be highly specific to the long-leafed wattle, and application has been made for permission to release it.

Host specificity testing of a rust fungus, *Uromycladium tepperianium*, for the control of Port Jackson, *Acacia saligna*, has reached an advanced stage, and consideration is being given to introducing it into quarantine in South Africa for final testing.

Chemical control of weeds

Jointed cactus - New weedkillers are being tested on a routine basis for the control of jointed cactus. However, MSMA remains the most effective and economical for the control of this weed.

There is every indication that a locally manufactured wetting agent is extremely effective. Its use can bring about a saving of approximately 13% on spraying costs.

Prickly pear - There is no decrease in the efficacy of MSMA if it is injected into the stems of prickly pear as directed, without any wetting agent.

It is recommended that separate containers for MSMA, without a wetting agent, should be specified for the control of prickly pear, which in turn would mean a saving of about 27 % on the cost of spraying prickly pear.

Nassella - An application for the registration of tetrapion sodium at a dosage of 1 litre/ha for the control of nassella tussock has been submitted. This recommendation applies to conventional rucksack spraying as well as to aerial spraying. The reduced dosage will bring about considerable savings and also contribute to the more rapid recovery of treated pastures. It will also be considerably less toxic to indigenous beneficial grass species, and no decrease in efficacy for nassella control has been recorded.

Ecology and physiology of veld invaders

Long-leafed wattle - Contrary to the widely held assumption that the mortality of alien acacia seed in the soil is low, it has been shown that over 90 % of an *Acacia longifolia* seedbank may be destroyed by fire. Viable seed of the long-leafed wattle has been found in the droppings of the red-winged starling (*Onychognathus morio*) suggesting therefore that this bird may be important in the dispersal of *A. longifolia*.

Chromolaena (C. odorata) - Additional information concerning the germination of the seeds has been obtained. Seeds remain viable for at least one year in the soil. Large numbers of viable seeds are produced annually, even in marginal areas. It has also been found that a copious soil seed reserve is present in infested areas, the majority of which are on or near the soil surface. Germination tests with these seeds have shown that up to 2 500 seedlings/m^2 can be produced.

Prosopis - Germination experiments have shown prosopis seeds to be very hard-coated but highly viable. Feeding experiments, where sheep were fed known quantities of seed, showed that this process destroyed up to 90 % of the seeds fed.

Nasella - Twenty per cent of the nassella seed bank present in the soil is destroyed by fire. The chances of veld recovery are therefore best if heavily to moderately infested areas are first burnt and then oversown with useful pasture grasses.

Pesticide dynamics

Application technology

Simple techniques were developed to test various characteristics of adjuvants. In a field experiment adjuvants doubled or trebled the efficacy of a herbicide, in post-emergence applications against many weeds.

The wetting, spreading, retention, anti-evaporant and penetrant power of adjuvants can now be measured, but minimum requirements for different situations will have to be determined over a number of years in extensive field trials.

Pesticide analysis

Over 600 fruit and vegetable samples were analysed for copper to determine whether the use of copper fungicides will leave a high residue in and on feedstuffs. It was found that none of the samples exceeded the legal limits.

Organic arsenical compounds used to control jointed cactus became suspect in cases of sheep poisoning, but analyses of the formulated compounds showed that only the organic arsenic compounds were present. None of the highly toxic trivalent arsenicals could be found.

Technical advice

Some 900 applications for registration and amendments to existing registrations of insecticides, fungicides and rodenticides and some 400 applications for herbicides, plant growth regulants and swimming pool remedies have been reviewed and recommended for registration (Act 36/1947) by the Technical Advisers. Almost 2 000 applications for re-registration have also been attended to.

The annual departmental publication *A Guide to the Use of Pesticides and Fungicides in the Republic of South Africa* was extended and updated and appeared again during August 1984 (368 pp.). The Afrikaans version of this guide *Handleiding vir die Gebruik van Plaagdoders en Swamdoders in the Republiek van Suid-Afrika* was revised and updated after many years during February 1985 (274 pp.).

ANIMAL PRODUCTION RESEARCH

Large stock

Nutrition

At the Mara Research station, where rainfall was 31 per cent, 41 per cent and 42 per cent below the long-term average for the years 1981/82, 1982/83 and 1983/84, respectively, the performance of breeding cows, calves and young cattle was maintained at a very satisfactory level by drastically decreasing the stocking rate on the veld to as low as 1 LSU per 25 ha. Calving percentages during the three years mentioned above were maintained at an average of 79,7 per cent, 88,4 per cent, 84,7 per cent, 85,9 per cent and 90,7 per cent for the Africander, Hereford, Bonsmara, Simmentaler/Africander and Simmentaler/Hereford breeding herds respectively, and differed little from those recorded during better rainfall years.

The performance of the calves in terms of ADG between birth and weaning at 196 days old was very satisfactory and came to 0,88 kg, 0,86 kg, 1,05 kg, 1,07 kg and 1,09 kg for the Africander, Hereford, Bonsmara, Simmentaler/Africander and Simmentaler/Africander/Hereford, respectively, with some of the highest average weaning masses ever recorded at the research station, namely 206 kg, 202 kg, 243 kg, 248 kg and 250 kg for the breeds and crosses mentioned above.

Particularly high mass increases were obtained in the Highveld region with yearling steers on unfertilised and fertilised *Cymbopogon themeda* summer veld where half the animals were given a strategic concentrate supplement. Average daily mass increases of 1,27 kg/steer and 1,35 kg/steer on summer veld and summer veld plus supplement, respectively, were recorded. Increases without and with the supplement on fertilised summer veld were 1,37 kg/steer/day and 1,50 kg/steer/day, respectively. Super carcasses were produced with strategic supplementary feeding from both unfertilised and fertilised summer veld.

Simmentaler steers (18 months old) produced a greater income in excess of feed costs (R16 per steer) when fed with a silage ration as against a concentrate ration at Potchefstroom to a slaughtering mass of 490 kg.

One of the possible causes of the poor reproduction performance of beef cattle on Dohne sour veld could be a betacarotene deficiency. A dosage of 5 g of betacarotene per day during the mating season (120 days from the beginning of November) increased the occurrence of discernible oestrus to 91 per cent, as against the 67 per cent in the control group.

On the Bathurst experimental farm in the Eastern Cape region, kikuyu pasture is being evaluated for dairy cattle production. Three rotational grazing frequencies are applied with rest periods of 15, 30 and 60 days. These three management systems mean that three different crown height structures of the pasture are used, which is related to the availability, the ease of intake and the quality of the pasture. Preliminary results show an ADG of 558, 474 and 390 grams per heifer for the three treatments. Cows were given no concentrate and the average milk production from December 1984 to June 1985 decreased from 14,2 to 7,0 kg, 16,1 to 6,7 kg and 17,7 to 6,7 kg. The cows also showed a loss in weight of 34, 35 and 5 kg during the three treatments. During the growing season of the pasture, however, rainfall was poor.

Researchers of the Natal Region also evaluated kikuyu pastures and found that herbage quality of kikuyu remains very constant over the season but milk production from cows grazing these pastures declines as the season progresses, finally crashing in what is called the autumn slump. Better pasture utilisation, followed by the use of non-productive animals to "clean up" the pastures, resulted in the usual decline in milk production being arrested. Kikuyu has been found to accumulate high levels of non-protein nitrogen and nitrates as well as having an inverse Ca:P ratio. High non-protein nitrogen levels in the herbage have been shown to be adversely related to feed intake. Crude protein levels are related to intake levels of herbage. High protein and nitrate levels in the kikuyu depressed the digestibility of the fibre and nitrogen-free extract fractions causing a reduction in overall digestibility.

Grazing management and nitrogen fertilisation practices are therefore critical factors in the optimal utilisation of kikuyu pastures by livestock.

At the Animal and Dairy Science Research Institute (ADSRI) at Irene, researchers conducted a study on the differences in opinion on the feeding of urea to highly productive dairy cows during early lactation. It was found that an inclusion level of up to 1,6 per cent of urea (complete diet) can be recommended for moderate producers and 1 per cent of urea for high producers, if complete diets are provided *ad libitum* and low-degradable high-quality protein sources are also included in the diet.

Reproduction

Research on testis hypoplasia in Nguni bulls at the Groblersdal experimental farm of the ADSRI in respect of various parameters was quantified. A variety of deviations was found in bulls with hypoplasia, amongst others the over-development of the tunica media of the artery and a particularly small lumen diameter in the artery.

Researchers in Natal induced a loss in mass in cows with a normal sexual cycle until they entered their anoestrous periods. The cows lost an average of 103,4 kg or 21,8 per cent of their body mass and 1,1 per cent of their condition score before the sexual cycle stopped. The sexual cycle resumed after the animal's mass was 27,1 kg more and the condition score was 0,65 more than when sexual activity stopped.

The importance of good condition for a high fertility rate was proved at the Mara research station, where the stocking rate on drought-stricken veld was decreased to 1 LSU per 25 ha. Between 79,7 and 90,7 per cent of the cows calved, and between 81,3 and 91,7 per cent of the calves were born within a period of 42 days.

Breeding

Research into the maternal characteristics of 39 breeds (with the Bonsmara as the bull breed), using approximately 500 beef cows, is at present being conducted at the Vaalharts Agricultural Research Station. Three-breed crosses produce excellent results as regards weaner yield, the Brahman x Charolais/Africander and the Simmentaler x Brahman/Africander crossbreeds being particularly good. It is significant that the performance of the pure Bonsmara compares very well with all the crosses being evaluated. Intake studies indicate a direct link between the mass of the breed and the amount of grazing material taken in. In the case of the Hereford x Africander cross, however, intake is disproportionately high in relation to the mass of the breed.

The Departmental Nguni herd at Groblersdal at present consists of 102 breeding cows and 35 two-year old and 46 yearling heifers. Researchers of the ADSRI have divided the herd into 10 breeding lines to restrict inbreeding and the target is to keep approximately 25 breeding cows per breeding line. This target has already been reached with some of the breeding lines, and surplus female animals will be available shortly. Surplus breeding bulls are already available. The selection of breeding bulls takes place on the basis of performance under extensive conditions, while tick resistance is also taken into account. Cows are selected mainly on the basis of fertility (early calving and calving interval).

Small stock

Nutrition

The voluntary intake and digestibility of barley straw ammonified by various methods were determined in SA Mutton merino wethers in the Winter Rainfall Region. Voluntary intakes of 1,181 kg, 1,207 kg and 1,586 kg were obtained with urea ammonification, anhydrous ammonification and the oven method, respectively, while the digestible organic material values were 63,8 per cent, 59,1 per cent and 60,5 per cent for the three methods.

The value of old-man saltbush during droughts in the semi-arid areas of the Karoo region was once again confirmed by the results of a trial where pregnant Angora goat ewes were kept on old-man saltbush grazing. The ewes maintained pregnancy successfully on this grazing with a supplementary feed of 300 g of chocolate maize per day without the danger of abortion.

In the case of young, growing merino wethers on veld grazing at Glen, it was determined that they do require additional salt. An intake of 5 g NaCl/day appears to be sufficient. Under certain conditions higher daily intakes of NaCl definitely have a detrimental effect on body mass and wool production.

Research was conducted on the Outeniqua experimental farm in the South Coast subregion of the Winter Rainfall Region on the effect of single and combination supplements of copper, cobalt and selenium for mutton-wool sheep on irrigated kikuyu-rye grass pasture. Single supplements of copper and selenium resulted in a significantly higher body mass increase of 20 per cent to 25 per cent. The copper supplement also resulted in a significant increase of 12,5 per cent in clean wool mass. Results further indicate that the copper content of the pasture was relatively stable over a period of 1 year. Liver and plasma copper levels showed, however, that the animals experienced a shortage of this trace element during the year, with a marked low point in spring.

In a trial to determine the retention of copper from copper oxide needles and copper sulphate, retention percentages of 80 per cent and 54 per cent, respectively, were obtained after one month.

After three dry seasons, the basal cover of artificial Smuts finger pasture in the Highveld Region on Avalon and Vals River soil forms deteriorated to such an extent (as a result of die back and weed encroachment) that sheep could graze on the Avalon and Vals River soils for periods of only approximately two and four months respectively, during the summer of 1984/85. It has not yet been possible to explain the difference in favour of the Vals River soil form.

Despite the fact that protein energy licks are given to wet ewes in the Eastern Cape, their energy intake is still not sufficient to maintain mass during winter. A supplementary feed of 300 g of maize reduced mass loss from 8 kg to 6 kg, while increasing the mass gain of lambs from 8 kg to 10 kg. Mass loss in ewes was also less at lower grazing pressure.

Mutton sheep ewes in the Natal Region were subjected to a stocking rate on Italian ryegrass grazing of 20, 24, 28, 32 and 36 SSU/ha. No significant differences between the growth rate of the lambs could be noticed for the first 42 days on pastures. The 100 days mass (weaning weight), however, showed the following results, namely 22,7, 21,7, 15,7, 17,7 and 14,2 kg respectively for the different stocking rates.

Physiology

Feed intake and body mass in boerbok ewes were monitored from the age of 10 weeks to 83 weeks. Four break points (5 growth phases) were identified by researchers of the ADSRI. The break points occurred at the ages of 21, 30, 40 and 62 weeks. The first break point, at the age of 21 weeks, can be attributed to the first ovulation (puberty) while the second break point, at the age of 30 weeks, corresponds with the peak of sexual activity during May. Sexual activity then decreases and reaches a low point during July, which corresponds with the break point at the age of 40 weeks. A relatively low but stable period of sexual activity then occurs, lasting until the end of December, after which sexual activity again begins to rise. This point corresponds closely to the break point at the age of 62 weeks. It appears that, apart from the first break point at the age of 21 weeks that is linked to puberty, the break points may be associated every time with sexual activity resulting from seasonal influence.

The boerbok is an excellent performer in the grass-bush communities of the Eastern Cape. A management programme based on a multiple utilisation system of bush and grass, however, is essential for optimum production. Under the production system on the Adelaide experimental plot, the mass of kids increases by an average of 200 g per day and the kids reach a marketable condition at the age of 166 days. The carcass masses of single kids, twins and triplets are 17,3 kg, 15,5 kg and 14,6 kg, respectively. The corresponding dressing percentages were 46,7 percent, 44,4 per cent and 42,7 per cent. There is little variation in the eye muscle measurements of single and multiple kids. Rib-fat thickness was smaller in multiple kids. The correlation between slaughtering and carcass mass was 0,85 and that between body length and leg size was minus 0,46. The latter is in all probability a physical indication of the reason why certain types are referred to as "quality goats".

Reproduction

At the Karakul experimental farm at Upington, it was found that sexual maturity in ewes, as opposed to rams, is influenced by the season of birth. Nutrition during the development phase of ewe lambs plays an important role. Poor nutrition not only has a detrimental effect on the age and body mass at which conception first takes place but also on future reproductive ability.

Fertility results of locally frozen (straws) Borola-Merino and Karakul semen at the ADSRI reflect lambing percentages of 10 per cent and 32 per cent, respectively. In contrast with this, conception figures of 41,7 per cent and 62,5 per cent were obtained with imported frozen Finnish Landrace (granules) and Lacaune-Merino semen (straws) after three cycles.

A new CIDR progesterone applicator was evaluated as a synchronisation agent. It would appear that the CIDR applicator results in a more compact oestrus response and in an induced oestrus period closer to that of the natural oestrus period.

Breeding

An experiment was conducted at the Koopmansfontein research station from 1965 to 1982 in which selection for weaning mass and selection according to breed standards in Dorper sheep were investigated. A control flock was also included in the study.

As regards selection for weaning mass there was no correspondence between selection differential and response. Response fluctuated erratically for both rams and ewes. The ewes in the flock selected for weaning mass were, however, appreciably heavier than the ewes in the control and the flock selected according to breed standards.

Selection according to breed standards resulted in high scores for attributes related to the general appearance of the ewes. The various methods of selection did not, however, give rise to any great differences in reproductive ability. There was furthermore little difference in the post-weaning performance and carcass characteristics of lambs from the various flocks.

Research into the correlation between reproduction and production characteristics of the Tygerhoek Merino herd in the Winter Rainfall Region brought to light the fact that the average lifetime conception figure, multiple births and the weaning percentage are directly and positively linked to 18 month old body mass. Neither direct nor indirect selection for increased clean wool production was found to have a detrimental effect on reproduction.

Pigs

In consequence of the Wheat Board's announcement that feed-grade wheat would in future be available as an energy source for farm animals researchers at the ADSRI conducted a study on the comparison of wheat with maize for use in pig rations. Wheat has a higher protein content (13,7 per cent as against 8,5 per cent in maize) and a higher protein digestibility (86 per cent as against 76 per cent). The digestible energy content of wheat, however, is somewhat lower (13,5 MJ/kg as against 14,2 MJ/kg). No difference was found in the growth performance of baconers.

Lysine would appear to be the major restrictive amino acid in pure barley diets, while threonine, methionine and tryptophan, in that order, have the greatest effect on urine nitrogen excretion. Research is being conducted to determine whether the last three amino acids are restrictive in that order.

In a comparative test of semen parameters, such as total volume, filtered volume, sperm concentration per ml, sperm production and pH, conducted by the ADSRI, significant differences were found between individuals and between breeds

(Large White and Landrace).

Successful venous catheterisation of young sows was brought about for regular blood sampling over relatively long periods of time. The catheters were still functional after three months.

Ostriches

A fundamental study on the energy metabolism and fibre digestion of ostriches is at present being undertaken in co-operation with the ADSRI in the Winter Rainfall Region. Preliminary results point to significant fibre fermentation, particularly in the caeca and colons of ostriches.

The most important hatching parameters, namely hatching temperature and absolute hatching humidity, were established with the aid of diffusion hygrometry in ostrich nests in the Winter Rainfall Region. Extrapolation of the results to the artificial hatching process increased existing hatching results by 50 per cent.

Poultry

Nutrition

Research was conducted into alternative energy sources for broiler nutrition. Raw sugar was included in broiler rations up to and including a level of 40 per cent as a replacement for yellow maize without any detrimental affect on growth. Furthermore, yellow maize was replaced by grain sorghum (tannin-free) so successfully that even with total replacement no drastic differences in the growth rate were observed. Neither was there any marked difference in pigmentation up to and including a 50 per cent replacement of yellow maize by grain sorghum. Sorghum diets with levels of more than 50 per cent, however, did result in notably poorer pigmentation where foot colour was used as criterion. Further research is at present being undertaken into the use of sorghum as energy source for layers and attention is being given to synthetic pigmentation.

Breeding

From the analysis of data collected over a 12-year period, it would appear that the egg production of two Black Australorp lines and one Potchefstroom Koekoek line increased by 5,0 to 6,8 eggs per year. Egg mass decreased by an average of 0,5 g and age to sexual maturity decreased by an average of two days per year. Mortality also decreased drastically.

Animals

Nutrition

The utilisation of roughage by ruminants is usually supplemented with concentrate feed. It is often the case, however, that the more concentrate the animal is given, the less roughage it eats. A trial was conducted at the ADSRI to determine whether this phenomenon has any connection with energy control. Increasing quantities of energy in the form of a glucose-casein mixture were injected into the stomachs of sheep on a roughage diet to a level equal to 7 MJ ME/day. Energy infusion did not result in a significant decrease in roughage intake. It would therefore appear that the decrease in roughage intake where the diet is supplemented with concentrate is not the result of an effort to maintain a constant energy intake.

In order to establish a possible connection between relative energy deficiency and rumen filling, sheep on a roughage diet were made to walk at 3 km per hour at a gradient of 10 ° for a distance of 9 km per day to increase their energy demand. The average roughage intake and the level of rumen filling with and without exercise did not differ significantly.

The fundamental aspects of protein metabolism were studied in a trial using rats. The protein synthesis rate in the gastro-cnemial muscle decreased from 30 % in a 25-day old rat to 7 % in an adult rat. Net protein deposition decreased from 12 % to 0,8 % over the same period. These results will be used to plan more expensive follow-up work using pigs. The aim of the study is to quantify the protein requirements of pigs more accurately.

In the light of predicted protein shortages, researchers of the ADSRI are investigating the exploitation of alternative protein sources. It is estimated that leaf protein concentrates (LPC) from lucerne could increase the protein yield per surface unit by at least 75 %. Lucerne LPC was prepared by steam or water coagulation and contained 53 % protein, 3 % lysine, 12 % fat and 0,5 % fibre. This compares particularly favourably with a product such as soybean oilcake. Hot water preparation of lucerne LPC resulted in a higher relative nutritional value (57,3 %) than steam preparation (39,7 %).

Milk

High-quality milk is characterised by the absence of pesticides, antibiotics, iodine and heavy metals. Technique studies were completed in each of the fields. Country-wide surveys on iodine levels are nearing completion and a survey on pesticides is being organised. A new technique, the brilliant black reduction method, was developed to determine the presence of antibiotics in milk. A recommendation on this was made to the International Dairy Federation.

Milk production areas in South Africa are widely dispersed which means that milk samples for

bacteriological analysis taken on farms have to be transported to factories over long distances. Because of the high environmental temperatures in South Africa and the accompanying problems with the refrigeration of the samples, a chemical preservative had to be found. It was found that the antibiotic chloramphenicol, used in combination with sodium azide, does not kill the bacteria in milk samples but merely prevents them from increasing.

A new method of distributing milk that is very popular overseas was investigated. This entails having the consumers themselves filling their own containers with milk. Tests showed that subject to certain requirements being met this method of distribution could be used.

The change in milking techniques and storage, i.e. from cans to refrigerated bulk milk tanks on farms, has brought about a change in the microflora of milk and a need has arisen for quick bacteriological tests. Studies have shown that the Limulus and ATP tests are not suitable but that the direct epifluorescent filter technique is.

Dairy products

Research is being conducted into the processing of whey, a by-product of cheese manufacture, because it is such a good source of high-quality protein, minerals and other nutrients. The lactose in whey is broken down enzymatically to sweeter products for the manufacture of whey syrups, which are used as ice-cream sweeteners as a complete or partial substitute for sugar. Whey proteins are claimed successfully and used as a functional ingredient of food. As a foaming agent, emulsifier, stabiliser and jelling agent, whey protein gives better results than artificial products. Through the controlled breaking-down of whey protein, these properties can be improved selectively.

The *Tetrahymena* technique for the determination of the biological value of proteins was completed and can now be used to determine the nutritional value of various proteins.

The role of dairy products in human diet is frequently questioned by nutritionists. In-depth research is being undertaken in this respect to compare the effect of processed vegetable oils with that of dairy fats. Results have already shown that butter does not have a more detrimental effect on the growth pattern of broilers than processed vegetable oils. Notable differences do occur, however, in the development of unsaturated fatty acids in the liver, which causes lesions and leads to disease when processed vegetable oils are taken in as the only source of fat.

At present the ripening of cheese is still determined organoleptically, but research has shown that the determination of protein degradation products can be a relatively accurate method of monitoring ripening.

A newer, shortened method of evaluating pathogenic bacteria in dairy products was developed. Conventional methods took 72 to 120 hours, while the new method, which is based on a unique process of enzyme production, takes only 24 hours.

Meat

Researchers of the ADSRI investigated the effect of various vacuum packaging films on the quality of beef and found that methemoglobin, in the absence of oxygen, such as is found during vacuum packaging, is reduced to myoglobin and that the desired red-purple colour of meat is retained. When packaging films with a high oxygen permeability are used, oxidation of myoglobin and oxymyoglobin to methemoglobin takes place. This results in a brown colour, which is unacceptable to the consumer. Vacuum-packaged beef can be stored longer with a packaging film that has a low oxygen permeability rate before an unacceptably high percentage of methemoglobin is formed, shortening the shelf-life of the cut.

A carcass evaluation was made of young pure-bred and cross-bred beef oxen at four live masses. Preliminary results indicate that the later maturing breed and crossings (Charolais and Simmentaler) were significantly better as regards the growth rate and efficiency of the animal. The earlier maturing breed and crossings, however, produce significantly fatter carcasses compared with the later maturing breeds and crossings.

Leather strength (upper leather) was also correlated with the maturity of the animal. Later maturing breeds and crossings (Charolais and Simmentaler) gave a greater leather strength than earlier maturing breeds and crossings. Leather strength also decreases significantly as the animal increases in mass.

LIVESTOCK IMPROVEMENT

At present an average of 1 601 herds and 89 183 cows are tested every month under the **Dairy Cattle Performance Testing Scheme**. A total of 1,1 million tests, including control tests, were carried out to determine milk mass and butterfat, protein and lactose values.

A total of 369 young bulls were nominated for the progeny testing programme, 124 of which were found acceptable and 46 of which were purchased for testing. The results of 524 dairy breed bulls are published in the official bull analysis report.

For a variety of reasons the beef cattle industry is probably in a worse position than at any time since 1959, when the **Beef Cattle Performance Testing Scheme** was instituted. In spite of this, however, the Scheme has continued to grow and arouse interest. During the past year, membership increased by 87 to a total of 1 849. A total of 5 745 bulls were subjected to growth tests and a total of 379 871 masses were recorded on the farms of participating breeders.

During the year under review, more than 42 000 rams were evaluated under the **National Woolled Sheep Performance and Progeny Testing**

Scheme. This represents the same number of wool sample analyses as last year, although more than one third of that number were obtained from ewes which are no longer analysed. Data processing was done only in the case of ewes where raw fleece mass and body mass are used as the selection criteria. A pilot programme under which ewe productivity is recorded was started with 10 participants.

Despite the unfavourable climatic conditions, participation in the **Mutton Sheep and Goat Performance and Progeny Testing Scheme** increased rapidly. The number of breeders participating grew by 153 % from 1983/84 (217) to 1984/85 (550).

Breeders of 17 different sheep breeds, the SA Mutton Merino accounting for 65 % of the total, are taking part. The lambing data processed annually increased by 80 % from 1983/84 (37 004) to 1984/85 (66 674).

The **National Pig Performance and Progeny Testing Scheme** forms the basis of the pig stud industry in the Republic since 96 % of the annual registrations by the SA Stud Book come from members of the scheme. A total of 2 369 boars were received at the testing centres during the past year, and 1 789 completed the test.

Since 1974 feed conversion of the pigs entered for the scheme has improved by 13,3 % while C + K fat measurements improved by 22,5 %.

The Duroc breed is still tested on a regular basis and compares very well with the other breeds. The ability of this breed to cross-breed is contributing to a growing demand for breeding boars.

The **Random Sample Egg Production Test** at Irene did not come up to expectations as regards the 1983/85 results, probably because of the poor quality imported feed ingredients that necessarily had to be included in laying diets. Feed intakes were adversely affected and this resulted in low egg production. A relatively high mortality was attributed to Marek's disease and this also had a very detrimental effect on egg production. The same applied to the test at Glen, although the results there were slightly better than at Irene.

The **Random Sample Broiler Test** at Irene, which ran from 7 May to 25 June 1984, was very successful. Exceptional progress has been made in the broiler industry. Since 1975, when broilers were marketed at an age of 56 days with a mass of 1,811 kg, performance has improved so greatly that broilers now reach a mass of 1,878 kg at an age of 42 days. The average marketing mass is now 2,160 kg at an age of 49 days. The average production efficiency factor is at present set at 198; 10 years ago it was only 134. This is an indication of the progress made over the past 10 years with regard to breeding, feeding and management.

BLOOD AND CHROMOSOME TYPING

The blood group laboratory at Irene tested the blood of 4 943 cattle during the year under review; this is an average increase of 57 %. Blood samples from 1 681 stud bulls were tested and 1 222 parentage determinations were done.

The cytogenetic laboratory achieved a success figure of 97 % with duplicate blood cultures of 515 farm animals. Of these animals, 47 had abnormal chromosome counts. The abnormality generally found in cattle was the 1/29 translocation; one bull, however, was a mosaic. Eight dogs were examined, seven of which were cytogenetically abnormal, predominantly with autosomal translocations.

LIVESTOCK PRODUCT IMPROVEMENT

A variety of dairy products were chemically, bacteriologically and organoleptically investigated by the quality improvement laboratory.

The quality of butter was determined on receipt and after an incubation period of seven days at 20 °C. The results showed that the incubation period produced chemical, bacteriological and organoleptic deterioration in the butter.

With a few exceptions, the chemical and bacteriological quality of the skim-milk powder analysed was very good. The average bacterial count per gram was as low as 250 in the powder of some factories.

Virtually all cheese samples complied with the legal standard for fat in dry matter and according to the organoleptic evaluation the taste of the cheese was good. The routine analyses of ice cream showed that the products were of a high quality and complied with the legal requirements in every respect.

The bacteriological investigation of pasteurised milk supplied by large distributors showed that the bacterial counts per millilitre were sometimes too high. An important factor contributing to this problem was the high bacterial count of the raw milk delivered at the pasteurising factories. This indicates that extension among primary milk producers needs attention. The results further showed that the pasteurisers of single-producer suppliers supplying pasteurised milk did not always function efficiently.

Investigation of fresh milk products such as yoghurt, cream, flavoured milk and cottage cheese indicated that these products were generally of a very high quality.

On the strength of the monthly herd somatic cell counts it can be stated that good progress has been made in controlling mastitis in the herds of fresh milk producers in the Cape Peninsula. This effort to foster an increased awareness resulted in a decline of between 8,7 % and 13,3 % in the number of herds with unacceptable somatic cell counts. No significant improvement was observed in the case of the industrial milk producers, however.

Dairy training

During the year under review the following courses were presented by the Training Section:

Milko-scan, Milko-scan advanced, cream testing, milk testing and milk grading.

A total of 51 students attended these courses.

VETERINARY RESEARCH

The **Veterinary Research Institute** at Onderstepoort has a threefold function: research, the development and production of vaccines and specialized diagnostics related to research. In addition, technical advice is supplied in respect of the registration of stock remedies and, as far as possible, the queries of livestock owners are dealt with.

The research activities of the Institute are reflected by the 53 scientific publications written and published by its researchers during the year under review. Sales of its 52 different types of vaccines dropped to 129 million doses due to the drought and the recession, while diagnostic work increased from 300 000 to 360 000 analyses.

Internal parasites

The finding of previous years that lambs spontaneously reject the tapeworm **Moniezia expansa** at an age of 5 months, was followed up by trials to explain the mechanism of the self-healing process. The results obtained indicate that it is an age phenomenon and not a case of acquired immunity. It was also re-confirmed that the phenomenon does not occur in the case of **Thysaniezia** tapeworms, a parasite which - according to a recent survey - occurs wide-spread in the Eastern Cape.

The distribution of the worm **Stilesia globipunctata**, found for the first time in 1982 on a farm in the Heidelberg, Cape, district, was investigated by taking random samples at four abattoirs in the vicinity. This confirmed that the parasite does occur fairly wide-spread in the Winter Rainfall Region. Of 85 animals examined at the Bredasdorp abattoir, 82 % was infested. In contrast, no **S. globipunctata** was found at Barrydale, north of the mountains in the Karoo, while 70 % of these animals was infested with **S. hepatica**. The distribution of the two parasites therefore seems to depend on the region or the climate. It was also found that **S. globipunctata** survives in the animal for a long time, which offers an explanation for the fact that heavy infestations are found mainly in ewes. This finding is important in view of previous observations that **S. globipunctata** is probably more harmful to the animal than the other tapeworms.

The storage of frozen roundworm larvae in liquid nitrogen has now been followed up after 10 years. If lungworm is discounted, more than 90 % of the larvae of the 14 worm species concerned survived the period of freezing. The technique is virtually ideal for the preservation of worm strains in the laboratory. This means that the strains need not be kept permanently in animals where they change because of constant passage and where they can also be lost fairly easily or become contaminated with other strains.

External parasites

With the aid of new techniques surveys were undertaken in various parts of the country to determine the incidence of the different **Culicoides** species, and also their seasonal distribution and the viruses which they transmit. In this process 10 new species were added to the South African list, at least four of which had not previously been described. A study was also made of the localities where the larvae hatch. The survey also proved **Culicoides imicola** to be the dominant species in most parts of the country and also the major **vector** for **bluetongue** and probably also for **horse sickness**.

To investigate the distribution of **horse sickness**, susceptible **indicator donkeys** were used. They were kept at 12 strategic points in the Transvaal and subjected to regular serological examinations. The results confirmed the previous indications, namely that the disease spreads annually from the hot, humid North-Eastern Transvaal and Mozambique to the rest of the country when conditions become favourable.

Very good progress has been made with **heartwater** research and the ticks that transmit the disease. For example, it was found that both the wild guinea-fowl and the mountain (leopard) tortoise can act as alternative hosts for **Cowdria ruminantium**, and that **Amblyomma marmoreum** can be the vector in the tortoise.

The use of infested tick nymph material as **vaccine** has now been established after initial shock reaction problems were solved, and it completely replaced the old blood vaccine during the course of the year under review. However, the use of routes other than the intravenous one for applying the vaccine requires further investigation since it still gives less satisfactory results.

For the first time in history efforts to keep the heartwater organism alive in cell cultures for extended periods were successful. If this can now be developed into a true **in vitro** method for cultivating **C. ruminantium**, it would hold important implications for the study of the organism and also for further **vaccine development**. Good progress has also been made with the development of methods for the purification and serological determination of **C. ruminantium**.

The treatment of **sweating sickness** with hyper-immune serum was again investigated. The treatment is 100 % successful in sheep and pigs, but unfortunately only 80 % in cattle.

Parafilaria infestation remains a knotty problem in the Transvaal Lowveld. A well-planned dipping trial did, however, prove that regular weekly

spraying with pyrethroids reduced the cumulative incidence of blood spots on the skin from 90 to 3,2%.

It is therefore possible to control the flies that transmit **P. bovicola**. However, weekly spraying could reduce the tick population so drastically that immunity against tick-borne diseases might become a problem. Swedish researchers recently obtained promising results with insecticide impregnated ear tags for the control of face flies. A combination of dipping and ear tags could possibly offer the solution for the control of both flies and ticks.

Similar ear tags were also tested for the protection of sheep against **river midges (Simulium)** and they were found to be fairly effective. The control of the midges by treating rivers with **Baccillus thuringiensis** var. Israelensis was continued. Promising results were obtained within a limited distance from the point of application.

Viral diseases

During the year under review the final alterations to the **foot and mouth disease laboratory** were completed, and a start could be made with vaccine production. A comprehensive research programme is now in progress to identify and solve problems before commercial production will be continued.

Diagnostic tests for foot and mouth disease were mainly restricted to the testing of game and in the Klaserie district the first natural case of the disease in a giraffe was confirmed.

Research aimed at determining the incidence of foot and mouth disease in **buffalo** in Natal parks was completed with the result that no evidence of the disease could be found.

In the Kruger National Park it was found that SAT 1 and SAT 2 viruses circulate more rapidly in buffalo than SAT 3, but contagiousness for other species was limited to 4 weeks after infection. Fences therefore do serve a purpose in preventing spread of the disease from buffalo to cattle.

Attempts to transmit sheep-associated **bovine malignant catarrh** to cattle remained unsuccessful. In contrast, further proof was found that contact is not necessary for the transmission of malignant catarrh from **wildebeest** to **cattle**.

An outbreak of **abortions** in horses occurred in Natal and led to the isolation of an unknown virus. The isolate is now being further examined with a view to identification.

The **lentivirus** isolated from **jaagsiekte** cases last year was investigated. A survey showed that the virus occurs wide-spread in South Africa, is often associated with jaagsiekte, but only causes a very light pneumonia which is probably the reason why it was not detected earlier.

A laboratory for the diagnosis of **fish diseases** came into operation this year and a start was made with the standardisation of tests for the four known viral diseases of trout. A disease that caused serious losses in several trout enterprises in the Lydenburg district was investigated and an unknown **Streptococcus** was isolated.

Regarding **poultry**, four outbreaks of psittacosis (parrot disease) were reported during the year. A few cases of **Newcastle disease** occurred, but on the whole viral diseases of poultry were well under control due to effective immunization programmes.

Bacterial Diseases

A total of about 900 specimens were processed by the various laboratories involved in the investigation of bacterial diseases, mainly to isolate and identify the organisms involved.

Pasteurella is an economically important organism, causing pneumonia in feedlot cattle and pneumonia and blue udder in sheep. An increase in **Pasteurella pneumonia** in sheep and goats has been maintained reflecting the continued drought. Treatment is only effective in early cases, therefore prompt diagnosis and correct vaccination is vital. The use of the IBR vaccine in cattle is to be recommended.

Streptococcus is regularly isolated. A severe outbreak of Streptococcus D of trout occurred, affecting many farms in the Lydenburg area. **Histophilus ovis**, which can now be distinguished from **Actinobacillus seminis** by using more sophisticated tests, caused many cases of purulent and ulcerative vaginitis in ewes and infertility in rams in the Western Cape during the report year. Vaccination was shown to effectively protect rams.

Haemophilus somnus was isolated in cases of meningitis and pneumonia in cattle. The identification of **Haemophilus** isolates is improving, due to more sophisticated techniques.

Clostridium perfringens type C has been isolated for the first time in South Africa. It is a cause of haemorrhagic enterotoxaemia of calves, lambs and young pigs.

As "redgut" in sheep has been shown not to be caused by **C. perfringens** type A overgrowth, production of experimental vaccine for this condition should be terminated. Controlling the condition by including roughage in the diet has been shown to be highly successful.

Campylobacter organisms unassociated with reproductive problems are regarded as the cause of swine proliferative enteritis, a common enteric disease in post-weaning pigs which results in a loss of condition.

A wide spectrum of specimens are received from animals and man for the isolation and identification of **Mycoplasma** species. The availability of a monitoring facility at the institute for screening cell culture reagents proved invaluable, and progress is being made with the isolation and characterization of the 4 **Mycoplasma** strains suspected to be involved in infertility in rams and ewes.

Brucella abortus remains the single most important cause of bovine abortion. The other bacterial causes of abortion such as **Trichomonas foetus** and **Campylobacter fetus** caused sporadic

problems during the year. As far as the serodiagnostic test for **Brucellosis** is concerned, the present facilities are being utilized at maximum capacity.

Food and milk hygiene

Research in this field at the VRI includes studies in meat hygiene, feed hygiene and especially milk hygiene, with the emphasis on aspects of diagnosis and control of bovine mastitis.

Progress during 1984/85 has been particularly satisfactory pertaining to investigations on

(i) the interpretation of the so-called California Mastitis Test (CMT);
(ii) the original development of a technique for highly sensitive determinations of various carbohydrates (including glucose) in bovine milk;
(iii) stress-related dynamic fluctuations of udder health;
(iv) inter-laboratory standardisation in the RSA of the somatic cell counting in bovine milk, and
(v) the original development of a highly efficient technique for recovering prostaglandins and proscyclins from substrates.

Toxicology

Poisoning due to pesticides, poisonous plants and other toxins again took its toll in the livestock industry: **organophosphates, carbamates** and **chlorinated hydrocarbons** were responsible for the greatest number of mortalities.

Strychnine remains the most popular toxin for destroying vermin and for the malicious poisoning of domestic animals. Mortalities among vultures near Thabazimbi and in the Soutpansberg Mountains continue to cause concern. Of the 254 specimens analysed for strychnine, 100 (43 %) were positive.

The importance of **arsenic poisoning** among cattle and sheep again increased with the use of monosodium methyl arsenate to control jointed cactus.

Experimental poisoning with **Galenia africana** was induced and documented in a sheep for the first time. During times of drought sheep and goats ingest large amounts of this plant and this gives rise to the disease condition known as 'waterpens' (abdominal dropsy). Studies are in progress to determine the nature of the toxin and the lesions caused by it.

A new remedy against gifblaar, acetamide, was tested during the year under review. Indications are that it might have some value in the prevention of poisoning. Research aimed at the isolation and study of a variety of plant toxins continued, but no new results were obtained.

Biotechnology

Modern techniques to manipulate the genetic information of micro-organisms are increasingly implemented in the Institute's research programmes. During the year under review the first benefits were gained from a co-ordinated effort to stimulate this research. Since viruses have relatively simple genetic structures and because the molecular structure of the blue-tongue virus has been intensively studied for many years, it was decided to concentrate on BTV initially. Because this virus has a unique genome consisting of 10 segments of double-stranded RNA, techniques had to be developed to isolate these segments, and convert them into cDNA with complementary end sequences. Researchers then succeeded in cloning all 10 segments of one BTV serotype in **E. coli** by means of a plasmid vector. The cloned DNA segments will be used for sequencing in order to determine the amino acid sequence of certain important viral proteins, and also for cloning in expression vectors.

The purpose of this is to find a system that can synthetise the neutralisation-specific P2 antigen in a form that will make it suitable for use as a vaccine. When the amino acid sequences of the P2 antigens of the different serotypes become available and the differences can be established, means can be sought to make one synthetic vaccine that will give protection against all the bluetongue virus strains.

To further investigate the immunological properties of P2 and the other viral proteins, a series of hybridomas that produce monoclonal antibodies against them were developed.

During the year under review a start was also made with biotechnological research aimed at developing or improving vaccines against jaagsiekte, redwater, gall sickness and heartwater.

Diseases caused by blood parasites

Progress was made with the critical evaluation of the Onderstepoort **redwater** vaccine under field conditions after mortalities occurred following immunization on a few farms. **Babesia bigemina** was identified as the possible problem organism and a new attenuated strain was imported from Australia. Together with an adjustment in the method of vaccine production, this should solve the problem. The suspicion that the redwater vaccine strains were no longer tick-transmissible was also confirmed. Very promising results were obtained with attempts to breed **Babesia bovis in vitro**. Although the percentage of contaminated cells in the culture is still low, the medium was found to contain an antigen that effectively immunizes cattle.

A start was made with a study of **Babesiosis** in horses. Tick-transmission has not yet been established, but an effective indirect fluorescence test was developed with which to commence serological surveys of the incidence of **B. equi** and **B. caballi** among horses in South Africa.

Regarding **gall sickness**, special attention was paid this year to the possible freeze-drying of

Anaplasma species. The survival of freeze-dried **A. marginale** at -18 °C seems promising, as does the use of splenectomized sheep instead of cattle to test the infectivity of the vaccine. Subcutaneous and intramuscular application also give good results.

Vaccine and antigen production

Vaccine production dropped by 17,5 million doses to 129,5 million during the year under review, mainly due to a drop in sales of the following vaccines:

Virus vaccines: **7,0 million fewer doses**

	1983/84	1984/85	Reduction
	(million doses)		
Bluetongue	18,5	15,1	3,4
Lumpy skin disease	1,1	0,4	0,7
Enzootic abortion	3,5	2,7	0,8
Newcastle disease	6,7	5,3	1,4
Small quantities of chicken pox, infectious laryngotracheitis and Rift Valley fever			0,7

Bacterial vaccines: **12 million fewer doses**

	1983/84	1984/85	Reduction
	(million doses)		
Pulpy kidney	43	39	4
Botulism	7,8	3,8	4
Anthrax	15,8	14,1	1,5
Blackleg	9,5	6,5	3

Haemophilus vaccine sales increased from 5,5 million in 1983/84 to 8,6 million over the past fiscal year.

The increased demand for most of the small-scale vaccines continues (e.g. **B. bovis** 66 % increase, **E. coli** 44 % increase and inactivated **paratyphus** 54 % increase).

A start was made to prepare the stock antigens for poultry vaccines on specific pathogen-free (spf) eggs, but due to inadequate facilities production has been temporarily suspended.

The production of diagnostic **antigens** and therapeutic **antisera** was virtually the same as in the 1983/84 fiscal year.

The following special vaccines were also prepared for specific purposes:

	Doses
Cl. perfringens	33 200
Staphylococcus (dogs)	685
Pasteurella for sheep	34 550
Pasteurella for cattle	1 600
E. coli for pigs	615

Virus vaccines

Projects in this regard deal with the viability of vaccines, the destruction of foreign microbes by means of gamma irradiation, tests with detergents for the washing of cell culture glassware and the development of oil-emulsion vaccines against Newcastle disease and rabies in cattle and an improved oil-emulsion vaccine against three-day stiff sickness.

Bacterial vaccines

An oil emulsion vibrio vaccine prepared with the Span 85 emulsifier produces a much more stable oil emulsion and the immunity produced is very good. The aluminium phosphate adjuvant of **Clostridium tetanus** and **C. oedematiens** vaccines was improved by adjusting the pH to neutral. Practical problems in respect of bulk preparation of **E. coli** vaccines for cattle, sheep and pigs, were solved by using a concentration/filtration system. The semi-synthetic medium now used as standard practice in the preparation of blackleg vaccine facilitates planning and effects cost savings.

The combination vaccine for **Pasteurella haemolytica** and **Staphylococcus** (blue bag) was successfully prepared and large supplies of approved vaccine are on hand.

A three-in-one vaccine consisting of **Clostridium septicum, C. oedematiens** and **C. tetanus** was successfully prepared on a small scale. Preliminary tests for efficacy look promising.

A five-in-one vaccine consisting of the above-mentioned three-in-one vaccine plus pulpy kidney and blackleg was prepared, but preliminary results were not quite satisfactory and various aspects still have to be investigated.

Two semi-synthetic media were developed and tested for the preparation of pulpy kidney vaccine. Initial tests are very promising.

Finance

The further decline of 17 million doses in vaccine sales during the year under review was responsible for a reduced income of about R500 000. Measures, however, were applied timeously that enabled the vaccine factory to function within the framework of its income.

Due to adequate reserves of vaccine bottles and stoppers it was not necessary to increase the price of vaccines for the 1985/86 fiscal year. On the contrary, it was possible to reduce the price of a few poultry vaccines so as to be more competitive with imported vaccines.

Price increases of raw materials over the past fiscal year, e.g. biochemicals (59 %) and glassware (22,6 %), are alarming. Should this situation continue, it would have a negative influence on future price fixings of vaccines.

Quantities of vaccines (in doses) supplied to foreign countries

	1982/83	1983/84	1984/85
Argentina	20 000	140 000	-
Bophuthatswana	355 266	302 000	398 663
Botswana	21 004	455 665	198 675
Caprivi	-	1 690	-
Ciskei	2 960	100 550	13 212
England	-	725	1 026
France	800	6 000	1 250
Gazankulu	179 950	153 631	86 970
Israel	285 000	188 000	280 000
Kangwane	-	1 000	1 000
Kwandebele	24 730	48 526	23 070
Kwazulu	217 110	677 300	843 530
Lesotho	19 712	330	2 260
Lebowa	-	1 194 613	463 249
Malawi	2 792	404 800	363 560
Mauritius	-	1 800	-
Mozambique	-	27 000	-
Qwa Qwa	-	5 000	11 260
SWA	1 506 875	3 716 448	2 612 669
Transkei	56 670	102 828	188
Venda	6 330	435 555	647 934
Zambia	18 100	184 150	300 000
Zimbabwe	3 867 050	2 400 814	1 674 878
Swaziland	-	21 894	15 623
Total	**6 584 349**	**10 570 646**	**7 939 017**

Facilities

Replacement of obsolete apparatus and the purchasing of modern apparatus are progressing well. Replacement of air filters with in-line air-filters drastically reduced contamination in fermenter vessels.

An exceptionally effective emulsifier was taken into use and very stable emulsions are now obtained.

Liaison with the public

The greater part of the liaison officer's time was spent on the registration and handling of the 360 849 specimens received in the course of the year. This includes 1 847 specimens from African states. In addition 1 262 telephone calls were made, 302 interviews were conducted and 111 letters were written to give advice to livestock owners. A total of 172 foreign and 2 048 local visitors were received in 130 groups. These numbers do not include the scientists, who this year numbered 70 persons from 26 countries.

AGRICULTURAL RESOURCE DEVELOPMENT

RESOURCE RESEARCH

Land type surveys

Land type surveys of the resources of soil, terrain and climate are carried out on a country-wide basis in order to extend existing knowledge of the natural resources of South Africa. The results are published in the form of land type maps and accompanying reports in the series **Memoirs on the Natural Agricultural Resources of South Africa**. Three memoirs have been printed and a further two are nearly ready for publication. A computerised land type data file, from which soil and terrain data can be withdrawn, is now fully operative. Seventeen land type maps have been printed and a further four are ready for printing. Another five maps previously printed are being revised and the field work for a further 26 maps has either been completed or has reached an advanced stage. Field work has been completed for 83% of the White part of South Africa.

Peri-urban soil surveys

Semi-detailed soil surveys were continued in the Pretoria-Witwatersrand-Vereeniging (PWV) complex. The soil science information collected is made available to regional and urban planners with the object of identifying good agricultural land and retaining it for agriculture.

Soil surveys and investigations for irrigation

Reconnaissance and detailed soil surveys are carried out on proposed State and irrigation board schemes in order to ensure long-term success on the schemes. A total area of 74 100 ha was evaluated on a reconnaissance scale.

Reasonably homogeneous farming areas and description of potential

A technical communication containing an inventory of the available natural resources for the 57 reasonably homogeneous farming areas of the Highveld Region was published during the past year. A further technical communication on the agricultural potential of the magisterial districts in the Highveld Region in terms of dryland crop cultivation and livestock production was completed and is being prepared for printing. For each of the 48 magisterial districts the expected long-term yields of the 7 most important crops are given for all land types, according to data on reasonably homogeneous farming areas. Grazing capacities are determined for each homogeneous farming area within the magisterial districts and the livestock production potential is expressed in terms of large stock units. A classification of natural resources into ecotypes in the 57 reasonably homogeneous farming areas of the Highveld Region is being prepared.

Using the description of 196 land types, agricultural potential in terms of crop and pastoral production was determined for a development area in the Transvaal Region. The area includes 20 magisterial districts in the South-Eastern Transvaal and the Lowveld and covers about 8 million ha. A fairly complete description of climate in the area was compiled from existing information. Special attention was also given to the irrigation potential of Groblersdal and the Lowveld. Standards for various crops were obtained from existing research data. The intention is to do similar work on the whole Transvaal Region, and this could result in a reclassification of the reasonably homogeneous farming areas.

At present the Karoo Region is divided into 144 reasonably homogeneous farming areas in respect of veld and 3 in respect of irrigation.

Soil surveys with a view to farm planning

During the year under review the farms of 64 members of study groups in the Highveld Region, with an area of 37 525 ha, were completely classified and provided with land line maps. These soil identifications were undertaken mainly by trained members of study groups on their own farms.

With a view to the subdivision of agricultural land, 9 farms were comprehensively classified and provided with the necessary reports on potential.

Soil surveys for farm planning purposes were carried out on 3 000 ha of land in the Eastern Cape Region. Soil series identifications for soil conservation planning purposes were carried out at 89 sites. Veld condition determinations were carried out at 3 sites. Farming handbooks for three specific resource areas, viz the Paterson wheat area, Queenstown thornveld and the Alexandria coastal area, were completed.

Irrigation planning

Investigations, evaluation and planning in respect of irrigation schemes and site lay-out on new State schemes were continued, and the TBVC countries were advised on irrigation planning.

Soil fertility and plant nutrition

The AMBIC method of determining the P, K, Ca, Mg, Cu, Zn, Fe and Mn soil fertility status of soils in the RSA was developed.

Results of pot trials indicate that soils at Vaalharts and Upington may have a low S, K and B status, and this will be investigated by means of field trials.

It was established that the exchangeable K percentage, the total K content and the extractable K content are not reliable indices for determining the K status of soils, but that these analyses can be calibrated for specific soils.

The use of agricultural gypsum under dryland conditions in the Winter Rainfall Region significantly boosted the yields of winter wheat on three soils. The soils were not brackish, but the gypsum brought about a marked improvement in the air:water permeability ratio. There is very little properly classified information on the macro element status and ratios of cultivated and uncultivated soils in the Highveld Region. These aspects are now being investigated with regard to parent material, terrain position, soil series, leaching and soil horizons. Vertic (turf) constitutes the fifth largest area in the Highveld Region. There is very little scientific knowledge on the cultivation and fertilising of soils of this kind. Field trials under a stubble mulch were laid out in order to investigate the cultivation and fertilising requirements of the soils.

Soil chemistry

A suspension method for the evaluation of the neutralisation capacity of liming materials was developed with the aid of contract research.

CEC methods were investigated in respect of soil analyses for the resource survey and a new method was developed.

It was found that South African powdery furnace ash products have relatively low neutralisation values and that owing to the high transport costs and possible toxicity in respect of B and Mo, they cannot be economically used to ameliorate sour soils.

Water quality and pollution

Guidelines for the disposal of effluent in the RSA were published in an information bulletin issued by the Soil and Irrigation Research Institute.

A large number of *ad hoc* investigations into the disposal of effluent on land were carried out in terms of the Water Act, on behalf of the Department of Water Affairs. Studies on the mineralisation of the Fish and Sundays Rivers were completed, as was an investigation into the suitability of RSA dam water for irrigation.

A research team from NUCOR on which the Department was also represented, completed an investigation into the movement of water to a water table at the dumping site for radioactive waste.

Irrigation and drainage

Following an investigation into irrigation scheduling and its improvement in the Loskop area, irrigation scheduling is carried out in practice at the farm level with the aid of tensiometers; farmers are obtaining results very close to the water-yield curves for crops.

Soil-plant-atmosphere-water relationships

Factors that influence the incidence and consequences of plant moisture stress were investigated and it was established that when the surface of the soil is dry radiation energy is lost chiefly as perceptible heat. This excess heat does not appear to be sufficient to affect stomata response. It was also found that the moisture depth of a soil profile where the ET/PET ratio is starting to drop is not a unique value. Where nitrogen fertiliser is placed deep, higher leaf water potential and leaf surface indices are obtained than when nitrogen is applied to the surface.

Meteorology

A technique has been developed to estimate monthly average maximum and minimum temperatures at any given point in the country using geographical position and altitude at that point.

Monthly average rainfall has been mapped for the Winter Rainfall Region on a 1:250 000 scale.

A method of indexing drought intensity has been developed. The Palmer drought index is used on a routine basis at present. Further attention is being paid to the development of alternative indices.

A soil-water balance model is used to evaluate the risk of maize yield reduction as a result of moisture deficiency in a number of production areas. It is evident that there is no connection between drought risk and annual average rainfall but that soil moisture availability, rainfall during the growing season and rainfall distribution are the critical factors.

There is a delicate balance between economical advantage and disadvantage in the use of pine windbreaks for the protection of apple orchards, against wind damage. To achieve the greatest advantage, wind intensity and existing windbreaks must be taken into account when positioning new windbreaks.

Remote sensing

The Soil and Irrigation Research Institute, in co-operation with the Wheat Board, the CSIR and the Small Grain Centre, proved in the Highveld that winter grain mapping and yield can be gathered from Landsat MSA-data. Processed classification maps are very reliable and have a low cost and manpower input.

The Remote Sensing Division obtained its own image processing facilities.

Resource data bank

The resource data bank system, which was introduced in the Winter Rainfall Region during the past year, provides for the following types of data:

- Weather data
- Homogeneous land use unit descriptions
- Physical and chemical soil data
- Crop and crop standards and techniques data
- Land type classification data
- Statistics on farm business economics

The data is stored on grids, with a grid size corresponding to one minute of longitude/latitude (about one square km). These data banks, together with comprehensive retrieval facilities, will assist research and extension in the Region enormously.

Soil erosion research

Owing to the difficulty of handling large amounts of runoff and sediment, plots in the Natal Region were reduced in size to conform with the standard plots (22,1 m long by 3 m wide). Pertinent observations are:

- Organic carbon on the bare fallow plots reduced an average of 1 % during the year and the total sediment loss increased markedly.
- Most of the erosion on the tilled plots occurred during the first two months after planting.
- Far more soil and water was lost from the conventionally tilled plots cropped for silage than from the similar plots cropped for grain.

Tillage techniques are being evaluated with rainfall simulators.

Significant relationships have been obtained between soil loss and time during the growing season for maize under conventional tillage. Very low soil losses are being measured under conservation tillage.

Soil losses on pineapple lands in the Eastern Cape Region are determined with the aid of the rainfall simulator in respect of various cultural practices on various soil series. Seven plots have already been tested and the results clearly show that the first 18 months of pineapple cultivation are the most vulnerable period. During this period soil losses are 10 times higher than in the last three years of the pineapple plant's growing cycle. It was also found that mulch cultivation reduces soil losses 24 fold.

ENTREPRENEUR DEVELOPMENT

PROGRAMMED EXTENSION

Introduction

During the past year the **Winter Rainfall Region** has given full-time attention to the rewriting of its regional development programme, which will serve as a manual to be used for all future agricultural development in the Region.

The five subregions of the Region have been subdivided into 78 farming areas, on the basis of available land type data.

The available agricultural resources, with their limitations, have been described and research and extension problems encountered in practice have been identified.

At present 59 active study groups are involved in programmed extension in the **Highveld Region**.

Maize received the most attention from the study groups. The field husbandry study groups held 306 meetings, attended by 3 397 persons, at which 404 lectures were presented by officers.

In co-operation with extension officers, the Resource Development Section followed up previous soil classification courses by assisting 64 members of study groups to classify their farms fully and supplying them with land line maps. Members of study groups classified about 37 525 ha of land on their own farms in this way.

With a view to implementing the Department's National Extension Strategy, all extension officers in the **Free State Region** attended a course on the strategy. The Region is at present modifying all extension programmes so that they comply with the principles of this strategy.

Resources and technology

There is approximately 370 000 ha of land under cultivation in the South-Eastern Transvaal Subregion of the **Transvaal Region**. Of this area almost 12,0 % is fully protected, and 38 % is partly protected. Few or no protective measures are applied on the remaining 184 000 ha.

Water erosion is the most frequent problem and surface erosion on cultivated land is particularly troublesome. Wind erosion does occur but is less serious.

Mulch cultivation is gaining ground. It is estimated that between 20 % and 25 % of the farmers already apply mulch cultivation successfully, and 20 % of the farmers are switching over to this type of cultivation. In co-operation with the Directorate of Agricultural Engineering, the subregion is conducting a study on expected run-off from land under mulch cultivation.

Programmes to promote optimum resource development in the high rainfall sourveld areas of Volksrust and Belfast are in progress.

The long-term goal is to assist the farming communities with the identification and solution of their farming problems. The first step was to carry out surveys in the areas in order to identify problems. An important problem according to both the cattle and sheep farmers in the Belfast area is wintering. The condition of the veld and production also constitute an important problem, however. For this reason the members of the conservation committee receive a thorough training in veld evaluation and correct veld management.

In the Silverton ward of the **Transvaal Region** *ad hoc* extension predominated, owing to the large number of smallholdings. Extension officers started working with groups of farmers in the ward who produce particular commodities. As a start the peach farmers were selected because they were already involved in extension work. The control of weeds also received a great deal of attention.

Subdivisions and changes in the use of agricultural land were a major issue in the Pretoria-Witwatersrand-Vereeniging area. There is an increasing need for land for roads, railway lines and urban expansion. The consequent investigations are being very meticulously carried out so that good agricultural land is not sacrificed unnecessarily.

A programme for the control of the declared weed jointed cactus *Opuntia aurantiaca* was started in the Zeerust Extension Ward. The infestation occurs on about 700 ha and five land users are involved in the programme. Extension inputs have resulted in public awareness of the weed problem and a further 13 cases were reported and spray was supplied. *Opuntia imbricata, Opuntia ficus-indica* and other *Opuntia* species are involved.

The main conservation efforts in the **Natal Region** have been directed through the conservation committees. However, these committees did not concentrate on conservation alone but were seen as planning committees and arranged courses and farmers' days. These groups were active throughout the whole Region and played an important role in the extension strategy.

Different types of study groups continued their work; these were mainly mail-in records groups but there were beef study groups as well. The main thrust was to establish pasture study groups in different parts of the Region.

Crops

In the **Winter Rainfall Region** the four wheat study groups in the Swartland Subregion studied various production techniques with a view to optimum production. A great deal of attention was also given to grain masses, sowing densities and yields. The information acquired was transmitted to farmers at meetings of agricultural societies.

The cultural practices and implements required for mulch cultivation were again investigated in

co-operation with the crop production section at Elsenburg and the Directorate of Agricultural Engineering. Several farmers have already started applying various types of mulch cultivation.

In the Boland Subregion special emphasis was placed on establishment advice, especially in the case of perennial horticultural crops, and advice was given to 134 farmers. 642 profiles were examined in the process and this involved 766 ha. In the Wellington Ward 38 % of the area that is expected to be prepared for perennial horticultural crops in the coming season was examined in this way and advice on establishment was given.

The deterioration in the cash position of farmers in the Boland Subregion resulted in their considering switching to alternative industries and extension officers had to supply advice on a wide range of possible alternative industries, such as irrigated wheat, maize, citrus and even Angora farming. In the Swartland Subregion potato production along the West Coast received attention, especially with regard to disease control and the prevention of virus infection.

Major inputs were made in the **Winter Rainfall Region** during the past year with the introduction of the cultivar guideline plan. This guideline plan quantifies the guidelines on adapted cultivars and rootstocks, by resource use unit, for the most important production areas.

In the North-Western Subregion the promotion of improved winter pruning and methods of dealing with summer foliage in the Olifants River irrigation area received special attention. Eleven farmers' days were organised, and were attended by 206 farmers.

In the Swartland Subregion specific attention was given to wine grape production techniques.

Practical studies are receiving a great deal of attention in the Christiana, Douglas and Vaalharts Extension Wards in the **Free State Region.** The demonstration unit at Vaalharts meets a major need and is a training ground for officers, conservation committees and farmers. The unit was visited by 64 farmers, chiefly for the evaluation of wheat, maize and cotton cultivars. Some 76 practical studies were undertaken on farms.

Practical studies in the Bloemfontein district again demonstrated the advantages of cultivating wheat under a fallow land system. Yields of 2,4 t/ha were obtained with a fallow land system, as against 1,5 t/ha under a wheat monoculture system.

Programmed work on wheat cultivation is undertaken in co-operation with the Wheat Committee of the Bloemfontein District Agricultural Union.

In the Barkly West Extension Ward the relative profitability of irrigated crops was compared with regard to lucerne, artificial pastures, cotton, maize, groundnuts, potatoes and wheat. The result is that 30 % of the 180 irrigation farmers use these data in planning their farming enterprises.

In the Lower Orange River irrigation area attention was given to maize and wheat with regard to cultivars, plant stands, fertilising and irrigation scheduling. It was apparent from the data that the maize cultivar PNR 473, with a plant stand of 34 000 plants per hectare, produced the highest yield.

In the Letaba area of the **Transvaal Region**, where subtropical fruit is the main kind of farming, special attention was given to novice avocado farmers to ensure that they plan their farming enterprises correctly from the beginning. Special attention was given to the planting of trees on suitable soil, the obtaining of healthy nursery material and measures to control root rot.

A programme aimed at the mango farmers in the Letaba Ward was started and a mango study group was established. The chief problems that received attention were packing, marketing, weed control and fertilising.

Attention was also given to macadamia cultivation - and particularly to fertilising, the choice of cultivars and pest and disease control. A study group consisting of six members met five times during the year under review. There are 11 study groups in the Nelspruit North and the Nelspruit South Extension Wards and they concentrate mainly on a specific type of crop. 142 farmers participated in the activities of these study groups.

The maize club of the Aliwal North district of the **Eastern Cape Region** has set itself the target of producing 20 tons of maize per hectare economically under irrigation. A yield of 13,65 tons per hectare was obtained by the winner of the annual competition.

In the **Natal Region** the first pineapple-block competition has been completed. Valuable results were presented and discussed at a farmers' day which led to the identification of research and extension problems.

As a result of rationalisation in the sugar industry as much as 20 % of the area planted to sugar-cane is likely to be withdrawn and suitable alternative crops will have to be found.

Stock farming

Situation determinations are carried out annually in the North-Western Subregion of the **Winter Rainfall Region** by means of mail-in questionnaires in order to determine the relationship between stocking rate and meat production per small stock unit and unit of area. The information obtained so far shows that a lighter stocking rate goes hand in hand not only with higher production per SSU, but also with higher production per unit of area. This shows that the official grazing capacities are realistic and are more profitable than the present higher stocking rate applied by producers.

Other projects being undertaken by the Winter Rainfall Region in these areas include programmes to promote more efficient veld management, better knowledge of pasture plants and the establishment of drought-resistant fodder crops.

The dairy study groups of Malmesbury and Durbanville specifically investigated the use of ammonified straw as roughage and the prevention of the "malkop" syndrome in cattle.

In the South Coast Subregion 3 dairy study groups held a total of 15 meetings.

There are clear indications in the Valley Bushveld of the **Eastern Cape Region** that many farmers are overstocking their veld. There has been a marked increase in interest in Angora goats, especially owing to their profitability during these difficult economic times. A programme aimed at improving managerial efficiency in respect of dairy herds in the Barkly West Extension Ward of the **Free State Region** produced an average increase in knowledge of 36% in the target extension group. It is estimated that 52% of the target group gained sufficient knowledge to run their dairy farms efficiently.

The quality of livestock was promoted by means of mini herd competitions in the Dewetsdorp, Rouxville and Verkeerdevlei districts. The number of entries increased from 22 in 1983/84 to 59 in 1984/85. The contribution these competitions make to the promotion of the quality of livestock and the care of young breeding ewes in particular should not be underestimated.

The main livestock promotion programme in the **Natal Region** was the dairy programme where the Cedara Dairy Rationing Program played an extremely important role as well as the Fodder Production Planning Program. Both computer programs are of great interest and value to dairy farmers.

Grazing

Surveys on the natural pastures were carried out in co-operation with the Agricultural Extension Institute of the University of Pretoria, as a supporting service for programmed extension in the **Free State Region**. The object is to identify the positive and negative forces that affect the application of veld management systems. Extension officers assisted 30 farmers to fill in questionnaires. The results will be announed by the Institute.

A comprehensive network programme to promote grazing management systems was drawn in the Molopo and Vryburg Extension Wards. Sixty meetings were attended by over 2 000 persons.

A programme was launched in the Brandfort and Theunissen Extension Wards to increase the efficiency of the livestock enterprise by applying adapted grazing management practices. Some 7 courses on different aspects of veld management were presented. In the course of various extension programmes, 47 meetings were held and these were attended by 1 000 persons. An attendance figure of 64% was maintained throughout the year.

The promotion of veld management systems in the Edenburg Extension Ward resulted in an increase in farmers' knowledge of plant identifications from 55% at the first meeting to 87% at the last meeting. Similar programmes are in progress in the Fauresmith and Smithfield Extension Wards.

The introduction of 54 grazing capacity zones in the Karoo Region and the further refinement of the capacities for each of the 144 fairly homogeneous farming areas constituted a gigantic task. Meetings were held to give the farmers of the Region information on the way in which grazing capacities are established and on the use of ecological indexing methods. The group camp approach to grazing utilisation was emphasised throughout.

The planting of drought fodder crops, especially old man saltbush, was advocated and a great deal of interest was aroused among farmers, as was evident from the numerous visits to the research institute and the great increase in purchases of seed.

The trend towards replacing veld with artificial pastures is continuing in parts of the **Eastern Cape Region**. This development has far-reaching consequences, namely a drastic increase in livestock numbers, soaring land prices, the subdivision of existing units and more intensive farming systems as a result of a tendency towards smaller farm sizes. The increase in artificial pastures may also be ascribed to the disappointing wheat crops and the stabilising influence of sheep farming on the farming systems.

Veld improvement was stimulated by short courses in the main grazing areas in the **Natal Region**. The veld grazing capacity map was revised where necessary and the veld burning regulations brought to the attention of the entire farming community.

The production of pastures was promoted by farmers' days and tours to successful farmers and research stations. The fodder flow computer program played an important role in stimulating interest in pasture production. Special study groups were formed in different areas.

FORMAL TRAINING

Training at colleges of agriculture is offered to prospective farmers at five colleges, namely Elsenburg (Stellenbosch), Grootfontein (Middelburg, CP), Glen (Bloemfontein), Potchefstroom and Cedara (Pietermaritzburg).

The following table shows student numbers at the respective colleges:

Student numbers at colleges of agriculture, 1983/84 to 1984/85

	1983/84	1984/85
Elsenburg	192	183
Grootfontein	103	102
Glen	140	133
Potchefstroom	141	144
Cedara	152	148

Courses are adapted regularly in order to keep pace with changing needs. During the year under review the admission requirements for the diploma in Winery Technology at the Elsenburg College of Agriculture were amended to make a diploma with viticulture as a main subject a prerequisite for admission.

AGRICULTURAL INFORMATION

Popular publications

During the year under review 106 new and revised leaflets were published in various series, and about 457 leaflets were reprinted unchanged. A further 53 information documents on crop production in the summer rainfall area were also published and distributed.

The number of newsletters which were edited and prepared for printing, increased considerably. A total of 115 issues of newsletters appeared this year, 56 more than in the previous year. In addition 71 Agricultural Reports of the foreign offices were printed here. A further 32 publications appeared as reports, manuals, lectures and technical bulletins. Departmental organisations were also continuously advised on compiling and planning programmes, newsletters, brochures and special publications.

Scientific publications

Articles - During the year under review 51 articles (50 English and one Afrikaans) were received - 13 less than the previous year.

Together with 49 articles left over from the previous year, the editorial committee dealt with 100 articles. Of these 61 (58 English and 3 Afrikaans) were approved, 30 (English) are still being considered, 7 (5 English and 2 Afrikaans) were cancelled and two (English) were rejected.

Of the 61 approved articles, 49 (46 English and 3 Afrikaans) were published, while 12 (English) are being carried forward. The year under review therefore ended with a carry-over of 12 approved articles and 30 that are still being dealt with.

Onderstepoort Journal of Veterinary Research - The following editions appeared during the year under review: Volume 51 (2), (3) and (4) and Volume 52 (1) in which 42 contributions were published. Thirty-eight articles were received during the year and nine were carried over from the previous year.

Other scientific publications - The following scientific publications appeared during the year under review: *Technical Communications* No. 185, 191, 192, 193, 194, 195 and 196; *Science Bulletin* No. 402; *Flowering Plants of Africa* Vol. 48 parts 1 and 2; *Bothalia* Vol. 15, 1 and 2; *Flora of Southern Africa* Vol. 4 Part 2, Vol. 14 and Vol. 28 (4); *Memoirs of the Botanical Survey of South Africa* No. 48, 49, 50 and 51; *Memoirs of the Natural Agricultural Resources of South Africa* No. 1, 2 (parts 1 and 2), 4 and 5 and *Agricultural Research* 1983 and 1984.

News service

The function of the News Division is to relay the Department's policy of optimum agricultural development to and through the media and other institutions and to promote the image of the Department.

This involves three primary tasks, namely the technical preparation and publication of *Agricultural News*, the daily preparation of two news bulletins in Afrikaans and English for *Calling All Farmers* and the compilation and distribution of press releases.

Agricultural News is published for 50 weeks of the year and is dispatched to all the major newspapers, agricultural journals, the SABC, leader farmers, politicians and about 184 rural newspapers. About 1 500 news items are printed in *Agricultural News* every year.

Agricultural News is increasingly used by the media and evaluation shows that many reports are followed up by agricultural journals and especially the rural press. The news presentation of some rural weeklies sometimes consists of as much as 60% *Agricultural News* follow-up stories or reports taken directly from it.

Regarding the news bulletins for *Calling All Farmers*, it can be reported that a total of about 2 640 words carrying the Department's image to thousands of listeners are broadcast daily.

Calling All Farmers

Research results and general advice on the production, harvesting, storage and marketing of agricultural products have received considerable coverage during the period under review. Veterinary matters and animal health too have enjoyed extended exposure.

Other disciplines to receive attention have included plant production - with the accent on biological control of pests and diseases, pasture science (particularly appropriate in the light of the National Grazing Strategy), the poultry industry and agriculture.

In addition to the many aspects of farming that have received attention, a wide variety of interesting reports on specific agricultural enterprises were broadcast such as for example, the series on Groot Constantia, the history of mampoer distilling, youth exhibitions, the land service movement and safety on the farm.

However, the backbone of our agricultural broadcasts continues to be our many interviews and discussions with farmers, research workers, officials of marketing boards, lecturers from various agricultural educational institutions and faculties, and from Organised Agriculture.

Audio-visual services

Slide series - Ten new slide series were made during the year, duplicated and provided with commentary on magnetic tape. The first multi-vision (nine projectors) computer-controlled programme on achievements in agriculture was screened more than 40 times during the year under review - mainly to visitors from abroad. A second multi-vision programme on maize production in South Africa is nearing completion.

During the year under review 422 slide programmes were lent to institutions and 23

programmes have been permanently issued to agricultural extension offices, research institutes and colleges of agriculture. More than 200 series were duplicated.

Neighbouring states, homelands, universities and Organised Agriculture are making increasing use of the Department's slide series. The University of Bophuthatswana has placed an order for 60 programmes. A delegation of agriculturists from Swaziland visited the Directorate for the purpose of creating a similar service.

Video - A video production unit was created, mainly for transferring existing slide programmes to video tapes. More than 40 slide series have already been transferred. A lending service of agricultural video programmes to agricultural extension officers and farmers will be launched in 1986.

Lending of slides - More than 1 250 colour slides, negatives and transparencies were lent to individuals and institutions during the year. Institutions assisted with slides include the SABC, the Faculty of Agriculture of the University of Pretoria, a seed company, the Wool Board, the SAAU, several schools and State departments. These institutions borrow the slides mainly for illustration and educational purposes and recognition is given to the Department for the use of the slides.

Documentation Centre

During the year under review the services rendered to researchers and extension officers by the Centre expanded. Apart from the 22 institutes/regions/directorates of the Department of Agriculture and Water Supply, about 50 researchers of other State departments and outside institutions (universities/boards/co-operatives/technical societies) avail themselves of the service.

SDI service - By means of the Department's Selective Dissemination of Information Service, 130 300 documents were retrieved for agricultural researchers and extension officers - an average of 10 858 documents per month.

The year commenced with 501 participants and ended with 600, and, although the average number of retrieved documents per profile increased to 56, the relevance percentage was exceptionally high.

Retrospective service - With the complete CAB data base (from its inception in 1972) at the disposal of the Centre, a large number of researchers and extension officers could be supplied with valuable scientific information. At present the contents of the complete CAB data base consists of some 1,625 million documents that are available to researchers through retrospective retrievals.

During the past year about 57 200 documents were supplied to 295 researchers, which represents a retrospective retrieval of an average 194 documents per person.

New data banks - The newly-created data bank NAVA which makes all registered agricultural research projects searchable, was further upgraded by bringing the newly-registered projects up-to-date.

A bibliographic data bank, ESLI (ecology/vegetation) was created. It contains some 3 000 references and the idea is to supplement it with new references on a regular basis.

For easy control and ready availability of overseas study and other tours of Departmental officers, a TRAVEL data bank was created. From this it is possible to immediately establish which officers visited which countries, for what purpose, for how long and whether State funds were used. At present more than 400 records are searchable. This data bank will be supplemented and kept up-to-date on a yearly basis.

Agricultural libraries

Central Agricultural Library - The library consists of 54 150 books, 84 494 State publications, 125 752 bulletins, 25 903 annual reports and 1 946 journals, 1 500 of which are current.

The more than 3 000 inter-library loan requests from other institutions bear witness to the important role played by the library at national level. AGROLIBRI appeared twice. The first edition of LANDBOUBIBLIOTEKE/AGRICULTURAL LIBRARIES, an agricultural library newsletter, appeared in March 1985.

Branch libraries - Senior library personnel visited the branch libraries during the year under review. The task of the libraries is reflected in the answering of 35 450 reference queries, the circulation of 106 254 journals to officers and the 11 710 inter-library loan requests received. The libraries made 9 343 inter-library loan requests to other institutions.

The library personnel act as liaison personnel between local researchers/extension officers and SADAL in respect of the distribution of retrieved documents and the channelling of queries concerning these.

AGRICULTURAL ENGINEERING SERVICES

Agricultural implements

Tractors - The Directorate has made considerable progress with the development of a testing procedure for agricultural tractors that will reflect both the power take-off performance and the field performance of tractors. Mathematical techniques by means of which the performance of tractors can be accurately predicted on the basis of basic specifications and engine properties are already available for two-wheel drive tractors.

Tined implements - Stubble cultivation with the aid of chisel ploughs is increasing. The Directorate evaluated a large number of chisel plough tines in respect of the mechanical properties of the tine and spring mechanism and the ripping properties.

Soil-engaging tools - A study was undertaken on the quality of parts that are available on the local

market, such as plough shares and chisel points. Observations showed that better control over the manufacturing and heat treatment processes is required, and attention is being given to the matter at present. Suitable materials and moulds for these parts are now chosen in co-operation with manufacturers.

Planters - Official tests on 13 single kernel planters are almost complete. These tests are far more extensive than previous testing programmes and include intensive field measurements.

Agricultural structures and facilities

Dairies and dairying equipment - A series of contributions for a handbook on the planning of farm dairies and dairying facilities have been received from collaborators from various disciplines and circulated for comments, after which the handbook will be compiled. Laboratory tests on nine brands of milking machines in the official testing programme have been completed. The results will have to be supplemented next year with extensive field tests and mail-in surveys before the test reports can be compiled. A computer programme by means of which economic analyses for the choice of intensive dairy housing can be carried out is now available. As in the past, a large number of dairy farmers were advised on the planning of new dairy facilities.

Beef cattle housing - The Directorate continued to provide services to the Animal and Dairy Science Research Institute at Irene with regard to the planning and construction of bull testing stations. A project on the planning of modern auction pens was tackled and standard plans for improved handling pens and a spray race were released.

Dealing with animal waste - Staff of the Directorate drew up a number of designs for lagoons on farms. The systems are still being monitored in order to evaluate them in practice and then review the original design standards accordingly. Considerable emphasis is placed on the necessity for separating solids when handling wastes. In order to provide effective equipment for farmers, prototype manure separators have been developed and field tests undertaken.

Processing animal feeds - Work has started on the drawing up of standard plans for feed processing facilities in feedlot systems. Further official tests have been carried out on new models of hammermills and test results have been published. The Directorate is continuing to render services to a number of persons and bodies in regard to the pelletability of a wide variety of stock feeds.

Facilities for sheep farming - The lack of plans for facilities for sheep farmers is a keenly felt need and consequently an engineer of the Directorate has been assigned to do research on the matter. An experimental round sheep dip with an inlet chute at a tangent is being built and will be evaluated. Attention will also be given to plans for shearing sheds.

Research on agricultural energy

Sunflower oil as fuel - A pilot plant for the routine preparation of sunflower esters has been constructed. A technique for the vacuum drying of the fuel, developed and designed at the request of the University of Pretoria, has been incorporated in the plant.

Two tractors have been placed on a farm near Rustenburg for the evaluation of a fuel mixture consisting of ester and diesel. Normal farming operations are being carried out and no problems have been experienced during the first season.

Solar energy - A locally developed solar windmill was installed at the Soutpan Experimental Farm for confidential evaluation. This is a mechanical unit and laboratory tests are being planned to supplement the results.

Hydraulic energy - Increasing interest in small hydro power units has led to the present investigation into the development of simple manufacturing techniques for crossflow water turbines. Equipment for the field evaluation of water turbines on farms has also been developed. Several hydro power systems have been studied on farms and advice on the systems given to the farmers concerned.

Wind energy - Available information on the performance of windmills has been collected and equipment is being built, in consultation with the CSIR, for the testing of complete windmill head units.

Irrigation and drainage

Testing of equipment - The Directorate's hydraulics laboratory has been further improved and automatised, which has made it possible to evaluate several sprinklers, filters, drippers and hydraulic valves and a travelling big gun more effectively. Official test reports on filters and the travelling big gun have been published.

Manuals - The comprehensive manual on the choice and use of filters for micro irrigation has been drawn up and published. After a comprehensive study an infiltration meter was developed to determine the infiltration properties of soils where high application rates, such as in centre pivot systems in particular, are applied. A manual on this type of equipment and its use was released. Comments from various collaborators were incorporated into a preliminary drainage manual, which was then republished.

Irrigation courses - Short courses on irrigation topics such as the use of the infiltration meter, the design of drainage systems and the use of the drainage manual continued to be presented to farmers, representatives of irrigation firms, designers of irrigation systems and extension staff.

The design of irrigation systems - In addition to guideline planning for the irrigation systems of several farmers, numerous smaller systems have been

designed for Departmental experimental farms. Staff of the Directorate were closely concerned with the planning of irrigation systems for the new Lowveld College of Agriculture at Nelspruit and for the Citrus and Subtropical Fruit Research Institute at Malelane.

Soil conservation

Rainfall simulators - Rainfall simulators were used to qualify the effect of cultural practices on farms in terms of soil losses and run-off. The results of earlier long-term erosion studies in Natal have been widely published and this work is now being extended to the Western and Eastern Transvaal and the Northern Free State. A further two seasons' work will be necessary before meaningful conclusions can be drawn.

Wind erosion - The construction of a mobile wind erosion simulator has been completed and the instrument is being calibrated at present under the guidance of a visiting expert from the USA. Comprehensive field tests are being planned for next year in order to identify cultural practices capable of counteracting wind erosion.

Donga erosion - The determination of the stability of dongas is an important aspect when deciding on the desirability of the construction of key soil conservation works. Studies were undertaken, some in collaboration with associates from overseas, in order to try to arrive at standards for donga stability. Certain standards have already been laid down for Karoo conditions. This work is being extended to other areas in the country. The construction of key soil conservation works has continued, and attention has also been given to the maintenance of works that have been in existence for a number of years. The stabilising effects of small, cheap structures within dongas are undergoing further investigation.

Instrumentation and electronics

The support provided by this section is indispensable to the work of the various divisions of the Directorate. Consequently the expansion of the section was continued through the improvement and expansion of the electronics laboratory and workshop and the enlargement of the staff. The following projects were tackled during the year under review:

- The development of central electronic control systems for the official laboratory testing of milking machines;
- the development of a control system for data collection in tests on irrigation equipment;
- the redesign of a digital read-out unit for tractor performance in the field;
- the provision of a computerised data assembly system for planter tests;
- the improvement of systems for data conditioning and collection with regard to tractor, engine and implement performance.

Government water schemes and drilling services

Following the introduction of the new dispensation in the course of the year certain functions were transferred from the Department of Environment Affairs to the Department of Agriculture and Water Supply. These functions included the drilling services formerly rendered by the Department of Water Affairs, the administration of irrigation boards, the provision of engineering services in respect of irrigation on the farm and the technical management of the schemes in terms of which irrigation works on farms are subsidised. In order to carry out these duties the Directorate has been expanded and each Region will in future have a Regional Engineer who will be responsible for the above-mentioned functions.

In the course of the year drilling services were taken over in their entirety and good progress was made with the transferral of other functions from the Department of Water Affairs to the Directorate of Agricultural Engineering and Water Supply.

In practice this amounts to an expansion of the activities of the Directorate of Agricultural Engineering and Water Supply in respect of soil and water engineering, which comprises soil conservation, irrigation and drainage. This expansion is indicative of an intensification of research and extension as well as a well-planned service to the farming community.

BOTANICAL RESEARCH

The two main projects of the Botanical Research Institute, namely the Flora of Southern Africa and vegetation surveys are lagging behind because of insufficient man power and financial support. These projects are of vital concern to our future because they are designed to supply information on which management of vegetation, essential for maintaining the plant cover of the country, is based. Maintaining an adequate plant cover is the only way in which desertification, the scourge of Africa, which threatens our very existence can be avoided.

Plant taxa

Flora of Southern Africa - Five fascicles are in the press namely Lamiaceae; Xyridaceae, Commelinaceae and related families; Crassulaceae; part of Rubiaceae; and Pteridophyta (ferns). A number of genera in the families Poaceae, Restionaceae, Liliaceae, Orchidaceae, Ericaceae, Salicaceae and Acanthaceae have been completed and will be published when the rest of their respective fascicles are ready.

History of plant collecting - Biographical information for about 80 additional collectors has been compiled, and is in press in *Bothalia*.

Palaeoflora of Southern Africa - The *Prodromus of Southern African Megafloras* is with the printers. This volume gives an overview of all the plants known from southern Africa during the time Africa was part of the supercontinent Pangaea (Devonian to lower Cretaceous).

Data - The PRECIS computer databank expanded to include plant names, synonyms and recent literature for the 24 000 taxa of plants in southern Africa. This on-line information service is the only one of its kind in the world. The listings for cryptogams and monocots are with the printer, and form part one of the *List of Species of Southern African Plants* (Edn 2).

Comparative grass leaf anatomy - The genera *Leptaspis* and *Streptogyna* of the subfamily Bambusoideae were studied and found to possess many bambusoid anatomical characters but cannot be accommodated in the core of the Bambusoideae. Nevertheless they definitely belong to this sub-family in a wider sense. Many members of the Andropogoneae (subfamily Panicoideae) were found to contain tanniferous cells. If these cells are shown to contain condensed tannins they could undoubtedly detrimentally affect the function of the rumen in mammalian herbivores and this could have important practical implications. *Eragrostis walteri* from the Namib Desert in South West Africa was shown to possess non-Kranz leaf anatomy and to utilize the C_3 photosynthetic pathway. This is the first record of a representative of the subfamily Eragrostoideae being C_3.

Wood anatomy - The stems of a number of *Rubus* species were studied and although variation exists among the taxa, the differences are not significant for taxonomic distinction.

Cytogenetic studies - Cultivated *Sorghum* lines were hybridized with wild *Sorghum* species of the section *Eusorghum* in an attempt to determine the relationships between them. Seed of specimens representing the sections *Chaetosorghum, Heterosorghum, Parasorghum* and *Stipasorghum* was multiplied. The basic chromosome number of 11 for the genus *Aristida* was confirmed. These results indicate that the tribe Aristideae has a basic chromosome number ($x = 11$) different from the rest of the subfamily Arundinoideae ($x = 12$). The taxonomic position of the Aristideae must, therefore, be reconsidered.

The investigation of the subfamily Festucoideae confirmed the existence of a polyploid series based on a basic chromosome number of 7. In the subfamily Panicoideae basic chromosome numbers of 9 for the Paniceae and 10 for the Andropogoneae were confirmed. Two exceptions were encountered: *Andropogon lacunosus* ($2n = 18$) and *Arthraxon lanceolatus* var. *lanceolatus* ($2n = 36$). In addition to these examples, an aneuploid *Heteropogon contortus* specimen ($2n = 46$) with a very abnormal meiosis was observed.

The reason for the abnormalities, which included asynapsis and anaphase I bridges, are currently being investigated. The basic chromosome number of 10 for the subfamily Chloridoideae was confirmed. The only exception was *Eleusine indica* subsp. *africana* with a somatic chromosome number of 36.

The cytotaxonomic study of *Rubus* indicated that hybridization between the indigenous and exotic species resulted in very aggressive hybrids. The indigenous species are propagated by means of seed and rhizomes, whereas the exotic species reproduce by means of seed and stem-tip rooting. A combination of these propagation methods occurred in the hybrids.

Vegetation

Transvaal bushveld and forest studies - The preparatory phase of research on the vegetation ecology of Sour Bushveld in the Transvaal Waterberg has resulted in development of computerized field-data capture, improved methods to increase collecting efficiency, improved plant identification aids and an objective approach to vegetation sampling. A pocket-sized apparatus was also developed for estimating both basal and canopy cover.

Refinement of the Braun-Blanquet phytosociological classification of vegetation in the Sabie area of the Eastern Transvaal Escarpment gave rise to 62 syntaxa arranged in an informal hierarchy, and comprising 53 plant communities (with 18 variants), 14 vegetation types and 4 ecological formation classes.

Vegetation types were mapped and subsequently integrated with existing land-type map units to provide an alternative, broader basis for landscape classification.

Coastal studies - In the Kosi Bay-Sordwana area of KwaZulu, first-priority sites for conservation of vegetation were found mainly on the dune barrier in the vicinity of Sibaya Lake. A previously unknown type of sand forest dominated by *Drypetes natalensis, Chrysophyllum viridifolium* and *Cola greenwayi* was discovered on the Mandosi Peninsula. After clearing for *Pereskia aculeata* control, regeneration of vegetation is rapid, the most common woody species being *Albizia adianthifolia, Dalbergia obovata* and *Tabernaemontana elegans*.

Articles on two estuarine systems in the Cape were published under the auspices of the Estuarine and Coastal Research Unit (CSIR).

Cape fynbos studies - Classification and description of western coastal lowland fynbos is well advanced. The 137 plant communities identified are classified into a hierarchy of four orders, 10 alliances, 14 suballiances, 59 associations and 37 subassociations, but 13 azonal wetland communities have not been ranked. The analysis of aerial photographs of selected sites indicated that the sand plain fynbos and the West Coast Strandveld become similarly invaded but at slower rates than West Coast Renosterveld and that annual manual eradication strategies can contain alien plant spread in West Coast Strandveld.

Investigation of environmental gradients showed that soil parent material has a major influence on the distribution of different plant communities, particularly in the mountain fynbos.

Preparatory work on ecological studies of mountain fynbos in the Cedarberg and Langeberg is well under way.

Mechanisms have been investigated to explain the sporadic nature of *Protea repens* seed germination. Techniques have been developed to accelerate the germination of these seeds. Germination capacity of representative sets of fynbos plant species are being investigated and compared to that of invasive alien plants.

Biomes - The biomes of southern Africa have been objectively determined. This has led to a re-assessment of previously recognized biomes and to a clarification of biome borders. New perspectives on plant-environmental relations at biome scale have been obtained.

Grassland studies - Preliminary work has commenced on two key study areas in the grasslands of the south-eastern and southern Transvaal, namely at Amersfoort and Grootvlei.

National Weed List - Over a hundred species were added to the List, to accommodate all declared invader plants, and all plants against which herbicides have been registered. Data on all the approximately 1 700 species in the list have been encoded.

Woody invaders - A survey has revealed a disturbingly widespread and effective invasion of the veld by a wide range of exotic species. These invaders threaten to change the landscape of grassy areas and to replace some indigenous woody communities such as streambank woodland.

Valuable veld plants

Indigenous food plants - The national food plant data-bank now comprises 1 409 species with supporting information. The bank was used in compiling a paper presented at the Kew International Conference on Economic Plants for Arid Lands.

Crop plants of African origin - Studies on the diversity of primitive crop plants continued, with the characteristics of 233 specimens of *Pennisetum* and 61 of *Sorghum* being recorded and analysed.

Conservation of germ plasm - The following seed was included in the germ plasm bank: 347 collections of *Citrullus lanatus*, 79 collections of other edible members of the Cucurbitaceae (or related bitter forms), 7 collections of edible legumes, 76 collections of *Sorghum bicolor* subsp. *bicolor*, 82 collections of *Pennisetum americanum* and 10 of *Lagenaria siceraria*.

Water conservation gardening - A publication (Department of Agriculture and Water Supply Bulletin No. 402) entitled 'A preliminary list of plants for water conservation gardening in South Africa' was published in November 1984.

Pretoria National Botanical Garden - New developments in the Garden include the landscaping and planting of koppies in the Karoo biome, and of a woodland stream on the main ridge. The last link in a circular, service road around the garden has been completed. Landscaping in the established parts of the garden is being up-dated e.g. a grove of tree aloes, *Aloe bainesii*, has been planted by the wrought-iron aloe gates which commemorate the late Dr G.W. Reynolds.

Research collections

Information - Plant specimens identified for officers of the Institute, various State Departments, Provincial Administrations, universities, neighbouring states, visitors from overseas and the general public numbered 25 901. Information was given to 2 254 visitors.

Development - The four herbaria of the Institute added 29 426 plant specimens to their collections.

Publications

During the year the following were published: *Bothalia* 15, 1 & 2; *Flowering Plants of Africa* 48, 1 & 2; *Memoirs of the Botanical Survey of South*

Africa No. 49 and 'A Review of the Southern African species of *Cyrtanthus*'. Ninety papers were published by members of the staff.

GRAZING RESEARCH

Karoo

Grazing research was officially started in 1934, at various experimental stations in South Africa. One of the original field trials begun in 1934 at the Grootfontein College of Agriculture is still being carried out without any change in experimental techniques.

The results of this historic trial incontrovertibly demonstrate the harmful effect of uninterrupted grazing and fixed summer grazing on both the veld and the livestock. Further significant and characteristic findings are that weed growth is promoted and the soil denudated as a result of summer grazing and that there is an increase in the number of grasses, with a stable cover as a consequence, as a result of winter grazing.

A great deal of progress has been made with the development of a simple practical and quantitative formula for determining the condition of the veld according to the plant species composition. The plant survey method is based on the principles of the descending point survey technique. This ecological indexing method is also suitable for estimating both present and potential grazing capacity. The ecological indexing method is accepted by farmers and extension officers as a very accurate and practical method of estimating grazing capacities. Research on the further refinement of this method is being continued.

Important work on the grazing habits of various kinds of stock on Karoo veld is being continued on various kinds of veld. Results show the important role multiple utilisation of the vegetation by various kinds of stock can play in boosting animal production per unit of area.

Natal

Different aspects of pasture research are dealt with in Natal under 59 registered projects. A project involving a survey of important plant diseases indicated that pasture production was hampered by pathological diseases to a far greater extent than had been expected.

Western Cape

The grazing capacities of various shrubs are being compared on the Nortier Experimental Farm in the Strandveld on the west coast of the Winter Rainfall Region. Grazing capacity is determined by having the plantings grazed by Dorpers and Merinos.

Estimates show that with a full stand of the shrubs (100%) during the four summer months (January to April) sand bitou can carry 14 sheep/ha, old man saltbush 10,5 sheep/ha and four-wing saltbush 8,3 sheep/ha.

Highveld

Extremely good results were obtained with veld grazing in the Highveld Region despite the drought. For instance, the production of meat (in terms of weaning mass) was as high as 249 kg/breeder cow in the treatment in question.

The performance of the veld is remarkable if the weaning masses of the animals that were entirely dependent on the veld are compared with those that wintered more intensively on silage, hay and crop residues, namely an average of 278 kg/calf for the veld group as against 265 kg/calf for the group that wintered on crop residues and hay. Furthermore, the high masses of the veld group were not achieved at the expense of the veld.

In an attempt to make wintering easier for the stock farmer, a mixture of palatable grasses consisting of Smuts finger grass, Rhodes grass and white buffalo grass was successfully used during the previous winter.

Free State

Drought characterisation - During the past year a study in which a model was used to define drought was completed in the Free State Region.

The results show that veld production can be very accurately predicted simply by using rainfall data. The application of this model makes it possible, *inter alia*, to distinguish between a man-made drought which is the result of mismanagement and overstocking and a true climatological drought.

It is foreseen that it will become possible to define droughts throughout the area scientifically so that man-made droughts that are the result of mismanagement will not be subsidised. There is also a possibility of introducing a prediction service to predict the incidence and intensity of droughts so that farmers can reduce their stock numbers in time.

Eastern Cape

Research in the Valley Bushveld of the Eastern Cape Region showed that the number of shrubs per unit of area is decisive to veld condition and therefore to grazing capacity. 8 800 shrubs/ha represents a grazing capacity of 9,3 ha/LSU, and 2 500 shrubs/ha a grazing capacity of 22,5 ha/LSU.

In the Central Grassveld of the Eastern Cape Region it was found that there is not a rectilinear decline in grass production with an increase in the number of *Acacia karroo* plants/ha and that maximum feed production (grass and bush) is obtained at approximately 850 tree equivalents/ha.

Maximum red meat production and maximum income/ha are obtained when browsers and grazers are combined in a grazing programme. The combination of browsers and grazers is a prerequisite for maximising animal production in the Central Grassveld. A system of this kind results in a 50%

higher red meat production than is obtained with a single species production system.

LEGUME RESEARCH

The unusual interest in legumes and other fodder and pasture crops is continuing. The protracted drought and the difficult economic conditions probably serve as incentives to producers to produce more feed on the farms. In addition to activities at Rietondale, work at the Nooitgedacht Research Station and in particular at the Burgershall Experimental Farm was expanded considerably.

Plant introduction - Seed samples were obtained from 80 species and cultivars.

Evaluation - 113 accessions were planted in nurseries for preliminary evaluation and seed production.

Yield trials with temperate legumes - Four yield trials were carried out under irrigation at Rietondale and a lucerne trial was conducted at Kempton Park in co-operation with a seed firm.

Eleven annual pasture legumes were compared at two levels of defoliation in a yield trial. These levels were no defoliation and defoliation whenever the stand became so dense that competition for light became a factor.

Defoliation led to a considerable increase in yield in *Trifolium resupinatum*. *T. batmanicum* and *T. pauciflorum* showed the same tendency, but to a lesser degree. For the rest defoliation reduced the yield in every case.

Analysis of the harvested material showed that defoliation stimulated nitrogen fixing. With the exception of *Trifolium hirtum* and *T. brachycalycinum*, defoliation led to an increase in crude protein production throughout, and in the case of *T. resupinatum* the figure was virtually doubled, namely 1 514 kg/ha as against 864 kg/ha.

The experimental results confirmed the outstanding production capacity of *Ornithopus compressus* and *Trifolium vesiculosum*. The regrowth capacity of *T. resupinatum* and its consequent ability to produce protein were very impressive, however.

Yield trials with lucerne - The trial with 36 entries, most of which were aphid-resistant, which was established at Rietondale in 1982 has been wound up. The stand of most of the entries deteriorated a great deal during the past year and consequently the crops were considerably poorer than in the previous season. New yield trials with 30 entries have already been established.

Plant competition trials - The interaction between *Trifolium vesiculosum* and *Lolium multiflorum* in mixtures is being investigated at Rietondale to determine how alternate rows of the crops compare with mixing within the row in respect of establishment, yields and botanical composition.

The application of nitrogen boosted yields considerably, irrespective of whether the two components were mixed in the row or not. Alternating the rows ensured that there was an appreciable percentage of clover in the mixture throughout. The application of nitrogen reduced the clover component by stimulating the grass component, however. Where the two components in the row were mixed, the application of nitrogen caused the clover to disappear for all practical purposes.

Effect of nitrogen fertilising and defoliation on the productivity of white clover and white clover-grass mixtures - In the clover trial the highest total yields were obtained where defoliation was infrequent; a higher yield was obtained with six cuts than with 12 cuts.

With regard to the grass-clover trial, frequent defoliation (11 cuts), produced a slightly higher yield than infrequent defoliation (five cuts). This was in contrast with results obtained in the pure clover trial. It would appear, however, that frequent defoliation promoted the growth of the grass, which again indicates that the luxuriant growth of the clover tends to eliminate the grass by overshadowing it.

Combined cultivation of legumes and cash crops - The purpose of the investigation is to study systems of combined cultivation of non-related crops in order to strive for better utilisation. Legumes enjoy special attention owing to their potential importance as pastures or fodder and as suppliers of nitrogen to the systems. The trial to determine the effect of growing annual temperate legumes between rows of maize on yields and fodder production was continued at the Nooitgedacht Research Station during the year under review.

In the trial at Burgershall, where the effect of perennial legume cover crops on bananas was determined, *Aeschynomene falcata* virtually disappeared but *Glycine tabacina* is still doing well in the dense shade under the banana plants.

This cover crop did not supply sufficient nitrogen to the bananas during the first season, but since the completion of the nitrogen cycle the situation has changed considerably and the yields obtained are now virtually as good as the yields obtained from bananas receiving up to 400 kg of N a year.

Investigation of possible systems for protein production in the subtropics (Burgershall) - A number of subtropical crops with possibilities as producers of protein meal were discovered. The crops are adapted in climatic regions where it is very expensive to grow lucerne and for this reason it was decided to compare some of the less well known crops, such as *Desmonthus virgatus, Leucaena leucocephala* and *Stylosanthes guianensis* with lucerne.

The material is being gathered and processed according to the method that will be used in practice, namely by means of mechanical harvesting, dehydration and grinding. The trial will last four years.

AGRICULTURAL FINANCE

Agricultural Credit Board

The activities of the Directorate of Financial Assistance are determined largely by the Agricultural Credit Board, which consists of a Chairman, a Vice-Chairman and 10 members, who are appointed by the Minister of Agriculture and Water Supply.

The primary functions of the Board, which is an autonomous body, are to provide financial and other assistance to farmers and to make recommendations on the recovery of debts and matters pertaining to security for loans, subject to the directions of the Minister.

During the year under review the Board dealt with 8 121 cases.

Granting of assistance

As a result of emergency conditions and other negative economic factors, it was not possible to accede to all the requests for financial assistance of the kind granted to farmers by the Agricultural Credit Board. Consequently certain schemes in terms of which financial assistance may be granted by the Agricultural Credit Board were suspended for an indefinite period with effect from 24 August 1984.

The schemes that were suspended were loans for the purchase of livestock and implements, waterworks, the sinking of boreholes, the eradication of invader bush, afforestation, the effecting of improvements, the construction of housing for farm labourers and the purchase of agricultural land. This suspension applies to the Designated Areas as well as to the rest of the RSA. The assistance schemes under which it is still possible to apply for funds relate to the payment of debts (consolidation), production loans, emergency aid and soil conservation works.

The amounts granted by the Agricultural Credit Board during the year, and the number of loans and the number of rejected cases, are shown in Table 1 opposite each scheme.

TABLE 1

Scheme	Granted		Number of applications rejected
	Number of loans	Amount R	
Purchase of means of crop production (seed, fertiliser, fuel, etc.)	2 661	87 552 283	394
Purchase of livestock	26	439 671	53
Purchase of farm implements/equipment	4	93 830	16
Construction of soil conservation works	55	1 306 000	0
Building of waterworks	75	4 978 061	38
Drilling	13	86 652	1
Control of bush encroachment	-	-	-
Purchase of agricultural land and grants of land	98	7 867 301	66
Making or repair of improvements	4	268 969	11
Installation of a power-line and electrical distribution network	15	257 009	4
Establishment and/or management of a private forest	1	300 000	0
Payment of farming debts, including mortage debts	787	46 576 115	871
Housing for farm labourers - Coloureds, Greater Western Cape	72	1 028 762	4
Other population groups	63	1 132 079	2
Disaster aid			
Stock-feed scheme in scheduled grazing distress areas, including the transportation of drinking water for livestock	428*	74 687 969**	30
Flood relief scheme Boland, Karoo and Eastern Cape and areas affected by cyclone Domoina	59	4 456 607	2
Total	**4 361**	**230 734 308*** **	**1 492**

*Only new applications received
**Subsidies included
***Amount actually spent on loans - about R163 million

The reasons for the discrepancy between actual expenditure and the amounts granted by the Board are the following:

- A considerable number of applications that had been approved by the Board had not yet been settled by 31 March 1985, and some payments were in respect of grants made by the Board during the previous year.
- Between 50 % and 80 % of the grants made by the Board for disaster aid represent a subsidy and do not form part of the loan.
- There were savings on or cancellations of assistance that had already been granted.

Granting of assistance in designated areas: Northern and North-Western Transvaal border area

The Department of Agriculture and Water Supply (Directorate of Financial Assistance) makes a contribution to the development and stabilisation of the above area in the form of the granting of assistance in terms of the provisions of the Promotion of the Density of Population in Designated Areas Act, 1979 (Act 87 of 1979), as amended, read with the Agricultural Credit Act, 1966 (Act 28 of 1966), as amended. A summary of the applications dealt with in the period 1 April 1984 to 31 March 1985 is given in Table 2.

TABLE 2

Number of applications considered	Applications approved	Type of assistance	Amount granted R
52	44	Means of crop production	996 331
51	34	Payment of debts	1 630 236
3	3	Livestock	50 500
2	2	Implements/equipment	76 175
61	13	Land purchases	2 905 324
1	1	Soil conservation works	20 300
15	9	Irrigation works	629 961
0	0	Improvements	-
6	6	Electricity	192 046
2	1	Compromise/arrangement for extension	
193	**113**		**6 500 855**

The considerable difference between the number of applications for land purchases received and the number granted may be ascribed largely to the excessively high land prices and to a lesser degree to the poor financial position and inadequate knowledge of farming of applicants.

State land

All State land which has been identified as suitable for agricultural purposes and in which no other Government department has an interest is handed over to the Department of Agriculture and Water Supply by the Department of Public Works and Land Affairs. It is not the policy to sell State land out of hand, but to give all interested persons the opportunity to compete for the acquisition of the land on an equal footing. This can be done in three ways, viz -

- by inviting applications;
- by the sale of the land by public auction; or
- by calling for tenders.

The first method is applied in terms of the Agricultural Credit Act of 1966 and the last two in terms of the State Land Disposal Act of 1961.

If the land is offered to the public for sale through the invitation of applications, its availability is advertised on a country-wide basis in the case of an economic unit, but only locally in the case of an uneconomic unit since the latter type of unit has to be combined with other adjacent agricultural land or land in the immediate vicinity. In both cases all applications received for the land in question are considered by the Board strictly on merit.

Sale by auction or tender takes place only in exceptional cases.

During the year under review 6 781 ha of agricultural land to the value of R1 265 080 was granted to successful applicants.

Short-term assistance

Crop production loans are of a continuous nature and may be granted in all the recognised field cropping areas of the country. Loans up to a maximum amount of R50 000 per calendar year are available for this purpose at present.

As a result of the severe drought of the past three years and/or hail damage to crops during the past season, approval was granted for -

- the limit of R50 000 per calender year in respect of production loans in the summer field cropping areas to be increased for producers in the above-mentioned field cropping areas to R75 000 from 1 September 1984 to 31 August 1985;
- an interest subsidy of 2% on such loans to apply for the same period of 12 months, i.e. from 1 September 1984 to 31 August 1985;
- farmers in the above-mentioned summer field cropping areas who do not have the necessary means for the purpose and who cannot obtain the necessary credit elsewhere to use production loans partly for the payment of cash wages and maize meal rations to full-time Non-White farm labourers.

This scheme came into operation on 1 July 1984 and will continue until 31 August 1985.

Particulars in connection with applications for loans of this kind considered by the Board during the past two financial years are given in Table 3.

TABLE 3

Financial year and scheme	Applications considered			Loans granted		
	Number	Amount R	Average R	Number	Amount R	Average R
1983/84	1 504	48 266 335	32 092	1 273	35 834 619	28 150
1984/85	3 055	121 691 794	39 834	2 661	87 552 282	32 902

Long-term assistance

Table 4 gives particulars of applications considered by the Board during the past two years.

TABLE 4

Financial year and scheme	Applications considered			Loans granted		
	Number	Amount R	Average R	Number	Amount R	Average R
Land purchases						
1983/84	259	74 725 875	288 516	64	10 236 826	159 950
1984/85	85	20 810 165	244 825	19	3 740 125	196 849
Improvements						
1983/84	59	4 084 457	69 228	45	1 495 026	33 223
1984/85	34	1 178 707	34 668	19	525 978	27 683
Discharge of debts						
1983/84	2 576	342 661 310	133 020	1 377	82 176 362	59 677
1984/85	1 658	262 173 560	158 126	787	46 576 115	59 182
Soil conservation works						
1983/84	116	2 015 556	17 375	116	1 997 384	17 218
1984/85	55	1 338 439	24 335	55	1 306 000	23 745
Waterworks						
1983/84	248	10 243 103	41 302	191	5 224 863	27 355
1984/85	127	8 051 521	63 398	88	5 064 713	57 554
Housing for farm labourers						
1983/84	321	5 440 340	16 948	319	5 378 380	16 860
1984/85	141	2 285 516	16 209	135	2 160 841	16 006
Livestock						
1983/84	168	5 332 536	31 741	71	1 372 478	19 330
1984/85	79	3 242 950	41 050	26	439 671	16 910
Implements						
1983/84	58	1 956 667	33 735	24	555 716	23 154
1984/85	20	741 125	37 056	4	93 830	23 457

Drought assistance schemes

Subsidies on stock feed (Phased Assistance Scheme) - As a result of the protracted drought in Bushmanland and the neighbouring areas, assistance in the Phase 5 areas was again extended without any further accumulation of farmers' debts for stock feed. A new Phase 5 scheme was introduced in terms of which -

(i) livestock numbers are reduced to 50 % of the carrying capacity of the unit;
(ii) a 100 % subsidy on feed purchases up to a maximum of 600 breeding small stock (100 breeding large stock) is payable at R5 per breeding small stock unit (R30 per breeding large stock unit); and
(iii) the rebate scheme still applies in full;
(iv) an incentive of R1,00 per SSU (R4,00 per LSU) per month is payable on the stock reduced (sold).

It was necessary to extend the assistance granted in the rest of the RSA where the above-mentioned scheme is in force; only in a few areas in the eastern parts of the country did sufficient rain fall for the areas to be descheduled.

As a result of the above total stock feed subsidy payments increased to R68 902 000 as against R54 010 859 the previous year.

Drought assistance scheme for stock farmers in the pasture areas - The scheme, which was introduced on an experimental basis in the Transvaal Bushveld areas during the previous year, was extended during the year to recognised pasture areas of the RSA which were still scheduled under Phase 2 of the Phased Scheme and in which further assistance was justified.

On 31 March 1985, 24 districts or portions of districts were included under the stock grazing scheme and expenditure in this regard was as follows in comparison with 1983/84:

	1983/84 R	1984/85 R
Subsidies	1 104 864	3 181 818
Incentive	345 105	1 684 267
Stock feed loans	36 342	109 508

Stock feed rebates - By 31 March 1985 there were approximately 122 districts or portions of districts that qualified under one of the drought assistance schemes for the 75 % railage rebate and 44 districts or portions of districts that also qualified for the private transport rebate.

During 1984/85, R14 586 000 was spent under this item as against R19 288 000 the previous year.

Subsidisation of interest on carry-over debts and new production credit - The following measures were approved:

(i) The carry-over debts to co-operatives of farmers in the summer rainfall field cropping areas that were consolidated on 1 September 1984 and had to be redeemed over a period of six years would be subsidised by the State in such a way that farmers would effectively only pay 8 % interest during the first two years. A decision on further subsidisation of interest by the State after 1 September 1986 will be taken later.

(ii) An interest subsidy of 35 % on the Land Bank's lending rate that applies from time to time to cash credit loans to agricultural co-operatives for the provision of new production credit for the 1984/85 season will be payable by the State to the members of such co-operatives in the summer rainfall areas for a period of one year, from 1 September 1984 to 31 August 1985.

At present assistance of this kind is afforded to sugar-cane, table grape and deciduous fruit producers as well, at other rates and over other periods. During the period under review R125 902 145 was paid over to the Land Bank, as against R27 836 504 the previous year.

Disaster aid

Stock feed schemes - The intensity of the drought throughout the country increased to such an extent that expenditure in respect of all the different schemes increased considerably.

During the year expenditure was as follows:

Rebate on the transportation of stock feed	R 14 585 664
Stock feed loans	R 22 451 418
Stock feed subsidies	R 72 623 410
Incentive to reduce livestock numbers	R 2 478 343
	R112 138 835

During the previous financial year expenditure in this regard was R96 686 814.

Flood damage (Domoina) - The purpose of assistance under this scheme was to place farmers more or less in the same position as they were in before the flood. This assistance comprised loans to meet the actual costs of the repair and re-establishment of damaged irrigated land and dry land on which crops had been established, at fixed rates applicable to the crop concerned, the repair of damaged private roads, crossings and bridges, the repair and replacement of waterworks that had been damaged/destroyed, and the repair and/or reconstruction of soil conservation works that had been damaged or destroyed. Loans were subsidised by 75 % and farmers who do not avail themselves of loans qualify for the 75 % subsidy if the work is satisfactorily completed. Full particulars (Table 5) were made available to the Agricultural Credit Committees concerned.

TABLE 5

Applications received	Applications approved		Amount used up to 31/3/1985	
	Number	Amount R	Loans R	Subsidies R
Loans	56	4 380 476,00	450 353,00	1 389 158,23
Subsidies	223	6 238 059,74	-	1 632 272,11

Ex gratia - A 100 % subsidy is payable on land washed away in its entirety or where reclamation is not considered economically justified. Particulars are given in Table 6.

TABLE 6

Number of applications received	Applications approved, 1984/85	
	Number	Amount used up to 31 March 1985
139	129	R2 218 149,00

Water quota subsidies (Riet River and Kaffir River Schemes) - The assistance scheme was introduced in order to enable farmers to remain on their farms until sufficient irrigation water (50 % of the water quota) becomes available so that they can continue production. The Kaffir River Scheme applies with effect from 20 December 1984. No payments were made in respect of this Scheme during the period under review and the full amount of R2 315 797 was therefore allocated to the Riet River Scheme.

Recoveries, deeds and estates

Registration of mortgages and issuing of deeds of grant - Although funds available for assistance to farmers were fairly limited during the past year, there was an enormous increase in the number of documents registered (1 855 were registered). There was a slight decrease in the registration of mortgages (1 721 were registered) and only a third of the number of deeds of grant were registered (120). The enormous increase in the registration of documents was the result of the greater number of cases of renouncement. These cases all required urgent attention.

Consents and estates - There was an increase in the number of documents of consent that were drawn up and registered in which consent was given in respect of restrictions registered against the title deeds of properties under section 35 of the Agricultural Credit Act of 1966. Similarly there was also an increase in the claims proved against insolvent, deceased and agricultural credit estates. During the year under review 299 claims were proved.

Control over security - Notwithstanding vacancies in several service areas in the Republic, the services of Departmental outdoor officers were found to be indispensable in the recovery of debts and the exercise of control over doubtful cases. Some outdoor officers dealt with two service areas. There was an increase in the number of cases where State securities or funds were at risk owing to neglect or the insolvency of debtors.

Recovery of debts - About R37,4 million was collected and numerous requests for extension of payment were granted.

Outstanding debts - The amount owed by farmers in respect of financial assistance stood at R376 million at the end of 1983/84. This has risen to R495 million at the end of the present year.

AGRICULTURAL PRODUCTION ECONOMICS

RESEARCH

The Directorate of Agricultural Production Economics undertook several research projects in the field of the economics of agricultural production. In addition studies were also undertaken at a regional level.

Production factor studies

- The determination of an equitable remuneration for the management function in agricultural enterprises is still receiving attention.
- An investigation of methods of determining the value of agricultural land in the RSA was started.

Structure studies

- The development of an alternative method for determining minimum farm sizes is receiving further attention.
- *Ad hoc* research on the development and replanning of irrigation areas is being continued.
- A study on the benefit/cost analysis of investments in the public sector is being continued.
- The determination of the extent, nature and efficiency of part-time farming in the RSA has reached a final stage.
- The study of the economic viability of sunflower oil as an alternative fuel has reached a final stage.
- Research on the financial rehabilitation of crop farmers with liquidity problems in summer field cropping areas has been started.
- The project on success in farming and financial relations in summer grain areas has reached a final stage.

Operating and production cost studies

Comprehensive operating and cost studies are undertaken annually on a rotational basis in one of the three chief maize-producing areas and in one of the three chief wheat-producing areas, with supplementary studies in the remaining areas. Production costs for several other branches of farming are calculated from these studies, including costs for sunflower seed and groundnuts.

Comprehensive production cost studies were undertaken for maize in the Transvaal Highveld and for wheat in the Rûens.

Farm management techniques

With regard to the development of managerial aids and managerial information systems, the following matters received attention:

- Further research on the refinement and expansion of the income and cost estimates system (COMBUD system).
- Additional publicity for and the expansion of the financial record book for farmers.
- The design of a computerised financial mail-in records system based on the methods contained in the financial record book for farmers.
- The development of a planning model for determining optimum enterprise choice for farms in the Winter Rainfall Region.

Farm business economics with mail-in records as the source data

This is a continuous project which has been in progress for 19 years. The numbers of mail-in records collaborators who received analyses of their farms during the year under review (with numbers for the previous year in brackets) are as follows: Collaborators of the Directorate - 693 (812), divided into 114 (128) study groups; collaborators involved through co-operatives and whose farming enterprises were analysed by the Directorate - 443 (450), divided into 26 (28) study groups. At present 484 (502) farmers are on the computerised Transakplan 1 system.

Income and cost estimates

The computerised income and cost estimates system (COMBUD) now contains 400 estimates. (Of this number 100 are experimental estimates.) These estimates were printed in September and distributed individually and in the form of volumes. The implement costs guide, which is published annually, was brought up to date.

Business relations

In co-operation with technical researchers from the Regions and the research institutes, researchers from the Directorate worked on the following research projects:

- An economic evaluation of some crop succession systems in dryland conditions in the Central Free State.
- The inclusion of perennial pasture crops in sheep production systems in the grassveld grazing area of the Free State Region.

- An economic study of business relations in respect of fresh milk production in the Natal Region.
- The economic evaluation of fodder crop utilisation with Merino sheep in the Fish River Valley.
- The economic evaluation of the potential of artificial pastures in respect of small stock in the eastern coastal areas of the Eastern Cape Region.
- The economic evaluation of development studies of components of the dry grass-bushveld pastures of the Eastern Cape Region.
- The development and evaluation of a profitable stock farming system for the valley bushveld of the Eastern Cape Region, both in very poor condition and in good condition.
- The development, management and evaluation of an adapted stock farming system in the high rainfall sourveld area of the Eastern Cape Region.
- The influence of various feeding strategies on the economic efficiency of beef cattle farming in the summer rainfall field cropping area.
- Research on the economic benefits of mulch cultivation in the summer rainfall field cropping areas of the Western Transvaal and the North-Western Free State.
- A comparison of profit margins from weaner calf, steer and oxen production systems in the Northern Transvaal bushveld.
- The economic evaluation of milk and meat production from the Simmentaler on natural veld and dryland *Cenchrus* grazing on the Springbok Flats of the Transvaal.
- A strategy for continuing and renewing production from established citrus and subtropical fruit orchards in the bushveld area.
- The wintering of woolled sheep and other stock in the Northern Drakensberg pasture area.
- An economic analysis of dairy enterprises and their financial role within the farming structure of mixed farms in the summer rainfall field cropping area.

TRAINING AND ADVICE

Although the Directorate's primary task is research, an important contribution in the form of training and advice was again made.

Officers of the Directorate held 584 lectures and 214 practicals at the five colleges of agriculture. In the course of visits to and from farmers, at farmers' days and during short courses and by answering queries, the Directorate renders an extensive advisory service on production economics in agriculture. Fifty-eight lectures were delivered at farmers' days, at meetings of agricultural societies and during short courses.

SUPPORTING SERVICES

Biometric and datametric services

One of the most important services which the Directorate is still providing is assistance in respect of the biometric planning of research and the analysis and interpretation of results. Owing to the shortage of biometricians, specialist datametricians are playing a valuable role here. A few researchers were given invaluable assistance with theses and dissertations.

The necessity for providing in-service training for new members of staff in the use of biometric techniques and the interpretation of research results emerged very clearly and a considerable amount of time was spent on this.

Although staff have now been stationed at 14 centres, there is still a need for biometric consultation within the Department. Senior members of staff visited a few centres and were able to satisfy this need in part. Persons outside the Department are also occasionally given biometric and/or datametric assistance.

Applied research was undertaken in the form of an investigation into the use of plot residuals to ensure greater precision in experimental work. Important technical information is distributed on a small scale within the Department through scientific pamphlets, technical communications and the newsletter. The in-service training of researchers in the use of the biometric programme libraries through programmed learning courses is now regarded as more suitable than the training of groups. The maintenance of existing data bases and banks is still undertaken, and new ones are also receiving attention, such as financial recordkeeping for farming enterprises. Information systems that facilitate the management of centres are receiving more and more attention.

The demand for micro computers and mini computers and the accompanying communication facilities is still increasing. Determinations of needs were carried out for four centres during the year under review. Assistance with the choice of types of computers and the preparation of tender specifications have now assumed major proportions. Training the users of these computers appears to present major difficulties.

Research by other institutions

Contract research at universities

Sixty-three applications were received to have contract research done at universities. Four of these applications were not approved.

The universities involved were those of the Orange Free State, Potchefstroom, Pretoria, Rhodes, Stellenbosch, Witwatersrand, Natal, Cape Town, the Rand Afrikaans University, Port Elizabeth, Fort Hare and the Medical University of Southern Africa.

The departmental institutions on whose behalf the projects were undertaken are: Natal Region (4), Eastern Cape Region (3), Transvaal Region (2), Winter Rainfall Region (1), Highveld Region (1), Summer Grain Centre (12), Small Grain Centre (7), Oleaginous and Protein-rich Seeds Centre (1), Plant Protection Research Institute (10), Soil and Irrigation Research Institute (1), Botanical Research Institute (2), Citrus and Subtropical Fruit Research Institute (5), Horticultural Research Institute (4), Veterinary Research Institute (2), Fruit and Fruit Technology Research Institute (3), Directorate for Agricultural Production Economics (1). Total number of projects: 59.

Ad hoc research at universities

Seventy-seven of the one hundred and three applications received, were approved.

The following applications were received from the various departments at universities:

Departments of Oenology (3), Entomology (1), Biochemistry (9), Soil and Plant Nutrition (4), Geography (1), Agricultural Engineering (2), Agricultural Economics (1), Pathology (4), Parasitology (4), Physiology, Pharmacology and Toxicology (1), Zoology and Entomology (1), Animal Husbandry (5), Chemistry (1), Biological Sciences (1), Microbiology/Plant Pathology (11), Animal Science (4), Botany (9), Agronomy/Pastures (2), Horticulture (3), Tick Research Unit (1), Physiology (1), Poultry Science (1), Plant Production (1), Mammals Research Institute (2), Soil Science (1), Zoology (2), Genetics (1).

Foreign research fellows at universities

A total of six applications have been received from universities of which the following five were approved:

University of the Orange Free State (1), University of the Witwatersrand (1), University of Natal (1), University of Cape Town (1) and the Rand Afrikaans University (1).

ORGANISATION AND FUNCTIONS OF THE DEPARTMENT

The Department of Agriculture and Water Supply has the responsibility of promoting optimum agricultural production and the welfare of the farmers in the White population group of the RSA. According to the Constitution the Department is specifically responsible for the following services and assistance measures:

- Agricultural development services, including research, advisory services and extension
- Training at colleges of agriculture
- Financial and other assistance to farmers or prospective farmers or for the promotion of agriculture
- Irrigation schemes
- Drilling for water for agricultural and local authority purposes
- Subsidising of drilling and water affairs for agriculture and local authority purposes
- Financial assistance in respect of water-works damaged by floods

To accomplish this task the Department consists of an Executive Directorate with the Head of the Department assisted by six chief directors who are responsible for the management functions of the Department. At the level of implementation, 24 institutions, each with a Director in charge, are responsible for the specialised functions.

Executive Directorate

Agriculture Building, Beatrix Street,
Private Bag X250, Pretoria 0001

Dr D.J. Agenbach: **Head of the Department**

Chief Directorate

Co-ordination

Dr A.J. Heyns: Chief Director

Agronomy

Dr W.P. Grobbelaar: Chief Director
Dr B.J. Stander: Agricultural Management Adviser

Horticulture

Dr G.S. Bredell: Chief Director
Dr J.J. du Toit: Senior Agricultural Management Adviser

Animal Production

Dr F.J. van der Merwe: Chief Director
Dr P.J.S. Pieterse: Director
Mr J.A. Swart: Senior Agricultural Management Adviser

Farming Development

Mr J.J. Bruwer: Chief Director
Mr P.F. du Toit: Senior Agricultural Management Adviser (Pastures)
Mr G.W. Oosthuizen: Senior Agricultural Management Adviser (Irrigation)
Mr L.M. le Roux: Senior Agricultural Management Adviser (Extension and Training)
Dr D.M. Scotney: Senior Agricultural Management Adviser (Natural Resources)
Mr D. Grossman: Agricultural Management Adviser (Game Farming)

Auxiliary Services

Mr B.J. Dreyer: Chief Director

Specialised Research Institutes

Soil and Irrigation Research Institute
600 Belvedere Street, Arcadia. Private Bag X79, Pretoria 0001

Dr M.C.F. du Plessis: Director
Dr C.N. MacVicar: Deputy Director
Dr A.L. du Pisani: Deputy Director
Dr A.J. van der Merwe: Deputy Director
Mr J.E. Volschenk: Deputy Director

The Institute is responsible for the classification of the resources soil and climate of the Republic as well as basic research to promote the efficient utilisation of soil, water and fertilisers, to identify problems in this regard and to find answers to these problems with a view to the improvement of agricultural production and the protection of the resources soil and water. Soil surveys for irrigation projects and investigations into physical soil properties are also undertaken - particularly where brack and waterlogging conditions occur. In addition, the Institute is responsible for basic irrigation research and the agricultural evaluation and planning of irrigation areas. All agricultural meteorological research and data collection also fall under this Institute and the remote sensing component acts as the specialist centre of the Department. The Institute undertakes the chemical analyses of soil, water and plant material, not only

for this Department but also for other State Departments, Provincial Administrations and other bodies. It is also responsible for the inspection and analysis of fertilisers, stockfeeds, stock remedies and agricultural remedies in terms of Act No. 36 of 1947.

Plant Protection Research Institute
Agriculture Building, Beatrix Street,
Private Bag X134, Pretoria 0001

Dr I.H. Wiese: Director
Dr D.P. Keetch: Deputy Director
Dr V.D. Wassermann: Deputy Director
Dr B.W. Strydom: Deputy Director

The Institute is mainly responsible for advanced research at the national level on plant pathology, insect and animal pests and their control. This includes microbiology, taxonomy of fungi, identification of virus diseases, the freeing of propagation material from viruses, honey-bees, insects in stored grain, forest and timber insects, taxonomy of insects and nematodes, economic zoology, toxicology of insecticides and the biological control of insect pests and weeds. The Institute is also responsible for the examination and control of imported plant material and the control of migratory locusts.

Botanical Research Institute
Private Bag X101, Pretoria 0001

Dr B. de Winter: Director
Dr D.J.B. Killick: Deputy Director

The Institute undertakes basic research on the flora and vegetation of South Africa with emphasis on taxonomy, morphology, ecology and economic botany. The Institute also controls the Botanic Garden at Brummeria (Pretoria) and herbaria in Durban, Grahamstown, Kimberley, Pretoria and Stellenbosch.

Citrus and Subtropical Fruit Research Institute
Private Bag X11208, Nelspruit 1200

Vacant: Director
Mr A. van Oostrum: Deputy Director

The Institute is responsible for country-wide research on all aspects of the citrus and subtropical fruit industry, as well as nuts, tea, coffee and herbs.

Tobacco and Cotton Research Institute
Kroondal, Private Bag, Rustenburg 0300

Dr D.J. Rossouw: Director
Dr A. Streutker: Deputy Director

The Institute is responsible for research, including technological research, in the interest of the tobacco industry in all parts of the country.

Horticultural Research Institute
Private Bag X293, Pretoria 0001

Dr J.T. Meynhardt: Director
Dr W.P. Burger: Deputy Director

The Institute is responsible for all applied and fundamental research and specialised extension on vegetables, cut-flowers, ornamental plants and shrubs throughout South Africa. The Institute controls vegetables, flowers and ornamental plants research at Roodeplaat in the Transvaal Middleveld and cherry research at Emperani, near Ficksburg.

Veterinary Research Institute
P.O. Onderstepoort, Pretoria 0110

Dr R.D. Bigalke: Director
Dr C.J. Howell: Deputy Director
Dr D.W. Verwoerd: Deputy Director
Dr B.J. Erasmus: Deputy Director
Dr A. Pini: Deputy Director

The Institute is concerned with research on diseases of stock and game (infectious and others, including diseases caused by malnutrition), diagnostics, the preparation of vaccines and diagnostic aids, and the biological evaluation of dips and remedies submitted for registration.

Animal and Dairy Science Research Institute
Private Bag X2, Irene 1675

Dr J.H. Hofmeyr: Director
Dr J.C. Oosthuizen: Director
Dr P.E. Lombard: Deputy Director
Dr R.T. Naudé: Deputy Director
Dr H.S. Hofmeyr: Deputy Director

The Institute, at various centres throughout the country, undertakes performance and progeny testing at the national level, as well as fundamental research on the breeding, feeding and physiology of farm animals. The Institute is also responsible for dairy and poultry research on a country-wide basis as well as for the training of dairy technologists at Glen.

Fruit and Fruit Technology Research Institute
Private Bag X5013, Stellenbosch 7600

Dr P.G. Marais: Director
Dr J.H. Terblanché: Deputy Director

The Institute is responsible for research on deciduous fruit, and certain aspects of proteas as well as for research at national level in connection with certain technological aspects of fruits and other agricultural products. The Institute further renders a radiation and radio-isotope service in connection with agricultural problems in the winter rainfall complex.

Viticultural and Oenological Research Institute
Private Bag, Stellenbosch 7600

Dr J. Deist: Director
Dr P.C. van Rooyen: Deputy Director
Mr C. Kok: Deputy Director

The Institute is responsible for all research in the sphere of viticulture and oenology, inter alia, viticultural research in the Lower Orange River area.

Grain Crops Research Institute
Private Bag X1251, Potchefstroom 2520

Dr J.W. Snyman: Director
Mr J. de Kock: Deputy Director (Winter Grain)
Dr K.W. Pakendorf: Deputy Director (Oil and Protein Seeds)
Vacant: Deputy Director (Summer Grain)

The Institute is responsible for research on the improvement and cultivation of summer and winter cereals and high protein seeds and oilseeds.

Directorates

Agricultural Engineering and Water Supply
Private Bag X515, Silverton 0127

Mr C.T. Crosby: Director
Mr F.J.C. Hugo: Chief Engineer
Dr B. van D. Boshoff: Chief Engineer
Mr J. Veenstra: Chief Engineer

The Directorate has a specialised task and devotes itself to all engineering problems in the agricultural industry such as mechanisation (farm power and machinery), soil conservation, water utilisation, farm structures, handling of material, storage of vegetables, fruit and other assigned products, as well as all other engineering services with which the Department is concerned, such as the preparation and development of plots on irrigation schemes. The Directorate also administrates matters concerning bore-hole drilling services, irrigation boards and schemes.

Agricultural Information
Agriculture Building, Beatrix Street,
Private Bag X144, Pretoria 0001

Dr R.J. van Niekerk: Director
Mr Q. Momberg: Deputy Director
Mr L.L. Lötter: Deputy Director

The function of the Directorate is the distribution of agricultural information by means of the mass media. For this purpose use is made of scientific and popular agricultural publications, radio programs, audiovisual aids and press releases. The Directorate is also responsible for the maintenance of an agricultural information bureau.

Biometrical and Datametrical Services
Agriculture Building, Beatrix Street,
Private Bag X116, Pretoria 0001

Dr J.P. Jooste: Director
Mr J.N. de Bruyn: Deputy Director

The Directorate is responsible for bio- and datametrical services to the Department.

Agricultural Production Economics
Dirk Uys Building, Hamilton Street,
Private Bag X250, Pretoria 0001

Mr J.S.G. Joubert: Director
Mr B.J. van Wyk: Deputy Director

The Directorate's main task is to research the production economics of agriculture and to make known the research results and general production economics principles.

Financial Assistance
Opera-Plaza Building, Bank Lane, Church Square,
Private Bag X118, Pretoria 0001

Mr D. Barkhuysen: Director
Mr D. Franken: Deputy Director
Mr R. Johnson: Deputy Director

To provide financial and/or other assistance to deserving farmers and farming enterprises with a view to promoting the agricultural industry by means of loans in terms of various assistance schemes, the sale or leasing of immovable or movable property of the State that is suitable for farming purposes, and the institution of protective measures in the form of the suspension of legal proceedings against farmers pending the possible granting of one or other form of assistance and arranging for farmers to compound with their creditors. The Directorate administers the Agricultural Credit Act (Act 28 of 1966) and the Designated Areas Development Act, 1979 (Act 87 of 1979).

Agricultural Technical Administration
Agriculture Building, Beatrix Street,
Private Bag X116, Pretoria 0001

Mr H.F. van Zyl: Director
Mr S.O. Joubert: Deputy Director

Administrative support to management. Administers financial assistance schemes in respect of soil conservation works. Administers subsidies to Irrigation Boards, and to farmers for bore-holes, irrigation works, additional water-works, etc.

Agro-ecological Regions

The seven Regional Organisations of the Department are responsible, within their respective geographical areas, for the planning, development, promotion and application of farming systems based on optimum land use.

Each region provides an extension service in which the soil conservation effort is integrated and which also covers every aspect of farming. The research services are directed to the collation and releasing of scientific knowledge for the optimum use of the natural agricultural resources. The research personnel is also responsible for specialist extension work and for supplying training services to the agricultural colleges.

Highveld Region
Private Bag X804, Potchefstroom 2520

Dr J.D. Slabber: Director

Dr J.E. van Niekerk: Deputy Director (Research)
Dr J.J. Coetzee: Deputy Director (Extension)
Potchefstroom College of Agriculture

Research Stations/Experiment Farms - Potchefstroom complex (central research station), Bethlehem and Swartland (Ventersdorp) (gousiekte research)

Karoo Region
Grootfontein, College of Agriculture,
Private Bag X529, Middelburg, C.P. 5900

Dr P.W. Roux: Director
Dr A.J. Siepker: Deputy Director (Extension)
Mr H. Steynberg: Deputy Director (Research)
Grootfontein College of Agriculture

Research Stations/Experiment Farms - Grootfontein, Middelburg, C.P. (central research station), Carnarvon, Tarka Conservation Area, Hales Flats and Jansenville.

Natal Region
Private Bag X9059, Pietermaritzburg 3200

Dr P. Hildyard: Director
Mr S.D. Le Roux: Deputy Director (Extension)
Dr C.F. Sievers: Deputy Director (Research) Cedara College of Agriculture

Research Stations/Experiment Farms - Cedara (central research station), Drakensberg complex (Estcourt), Northern Natal (Dundee), Kokstad and Pongolapoort (Makatini)

Eastern Cape Region
Private Bag X15, Stutterheim 4930

Mr H.S. Niehaus: Director
Dr A.D. Venter: Deputy Director (Research)
Mr J.L. Vosloo: Deputy Director (Extension)

Research Station - Dohne (Stutterheim) (central research station) and Bathurst (Port Alfred)

A number of experiments are also carried out at East London.

Transvaal Region
Agrivaal Building, c/o Edmund and
Hamilton Streets, Private Bag X180,
Pretoria 0001

Mr D.F. de Wet: Director
Mr F.F.M. van Aswegen: Deputy Director (Extension)
Dr M.K.S.L. von la Chevallerie: Deputy Director (Research)

Research Station/Experiment Farms - Roodeplaat (central research station), Soutpan (Pretoria), Athole (Amsterdam), Loskop (Groblersdal), Mara (Louis Trichardt), Messina, Nooitgedacht (Ermelo) and Towoomba (Warmbaths)

Free State Region
Glen College of Agriculture, Glen 9360

Mr T.E. Skinner: Director
Dr N.J. Robbertse: Deputy Director (Extension)
Dr E.A.N. Engels: Deputy Director (Research)

Research Stations/Experiment Farms - Glen (central research station), Armoedsvlakte (Vryburg), Koopmansfontein (Barkley West), Rietrivier (Herbert), Sandvet, Upington complex and Vaalharts (Jan Kempdorp)

Winter Rainfall Region
Private Bag, Elsenburg 7607

Dr J. de V. Burger: Director
Mr A.F. Kriel: Deputy Director (Extension)
Elsenburg College of Agriculture
Mr M.C. Walters: Deputy Director (Research)

Research Station/Experiment Farms - Elsenburg, Mariendal (Stellenbosch), Langgewens (Moorreesburg), Nortier (Lambert's Bay), Oudtshoorn Outeniqua (George), Tygerhoek (Riviersonderend) and the Worcester Veld Reserve

Printed for the Government Printer, Pretoria, by Cape & Transvaal Printers (Pty) Ltd, Cape Town—BB4426/1 300

	RPP
	RMVM
	IB
	IF
	BSM